TASMANIAN INTERTIDAL MOLLUSCA

By RON C. KERSHAW,*

Text figures 1-2.

Honorary Associate in Malacology, Queen Victoria Museum, Launceston.

Abstract.

Study of the Tasmanian mollusca reveals several aspects of species constitution, of affinity, and ecology, which seem to support the conclusions of other workers dealing with general ecology and with relationships. Thus the mollusca are part of an ecological unit, the basis of which is ecological rather than faunal, with affinities for areas of similar latitude probably discernible. The mollusca are also, in general, part of a southern Australian faunal entity extending to New South Wales and southern Western Australia, yet with individuality, and even a little Neozelanic affinity. Available evidence suggests, however, that the Tasmanian fauna is, for the most part, disinct from that of tropical Australia.

Introduction.

In this work the mollusca are studied as a separate entity of shore life, but without divorcing it from other shore life, as has been the approach of students of the Tasmanian mollusca in the past. This approach has been influenced, and materially aided, by the studies of general ecology carried out in recent years. Thus it has become evident (as has been long suspected) that some bio-geographical individuality exists in Tasmanian environments. This may even extend to the Victorian coast, where there are many faunal affinities, as well as some distinction. In reverse there are hints of the presence of South Australian and New South Wales influence. The relative position of the Victorian exposed coast fauna has been made clear by Bennett and Pope (1953), who are inclined to include this area with Tasmania in a cool, temperate "Region." Guiler (1954*b*) is in general agreement with this postulation. Guiler (1950) reviewed most of the literature having a bearing on the ecology, to which reference will be made herein. Accordingly, only a few remarks will be made relating to certain literature having a specific bearing on the present subject.

W. L. May studied the Tasmanian mollusca over many years, and his work is summarised in his "Index" (1923). Iredale and May (1916) proposed to designate the east coast of Tasmania the Maugean Region, and Bennett and Pope appear to favour the extension of this term to cover all of Tasmania and the exposed Victorian coast as above indicated. The north coast of Tasmania, according to Iredale and May, is pure Adelaidean (since renamed "Flindersian" by B. C. Cotton). Some agreement with this idea is possible, but an overall study inclines one to the view that the fauna is Tasmanian. It is also (if one likes) part of a Bass Strait fauna, with affinities with its surroundings which are less marked to the east. Essentially the differences between North Coast faunas and those of other parts of Tasmania are due to ecological factors, such as differences of exposure, and so on. From a broader viewpoint, this was recognised by Bennet and Pope (1953), but that there is a Flindersian influence was

* West Tamar, Tasmania.

recognised by Hedley (1904). Hedley's basic idea has been partly confused because some of his evidence was ecological, and because nomenclatorial revision has altered other aspects. He does not seem to have envisaged the full extent of the probable Bass Strait land area, but to have realised all its vicissitudes would have been a remarkable achievement even for an author of his calibre. Without going into details, it may be considered that the land bridge did actually exist. There has always been the danger of calling into existence such a factor to account for a fauna which is itself then used as proof of that factor. In this case geological evidence is gradually forthcoming to support the hypothesis. Assuming the land bridge, Hedley's division of the fauna must have occurred, but because of migrations of the fauna and the length of time since the land vanished, intermingling has occurred and a balance achieved. Iredale, Laseron and others have shown that some factor (i.e., migration) has been in force in the past to bring Tasmanian faunal influences off the New South Wales coast and the reverse in regard to the Tasmanian coast. Smith and Iredale (1924) found evidence of a probable Pleistocene strandline on the continental shelf off the coast of New South Wales. Associated was a fauna directly comparable with modern Tasmanian molluscs.

The eastern fauna did actually come into the Bass Strait area, but it is less obvious. The influx of the sea on to the Bass Strait land surface probably may be definitely regarded as being principally of western waters at first, and it is not surprising to find some western influences on north-eastern Tasmanian shores. If a western migration into Bass Strait was the initial one, it is natural to assume that its influence would in the end predominate. But it must be realised that this fauna (i.e., that now found in Bass Strait with some modification) may simply have been returning to a formerly held "home." No doubt, by the process of adaptation formerly outside forms came here and were able to survive. In addition, the fauna has now tended to assume a character of its own. Probably we may summarise the present position by asserting that the obvious Tasmanian elements tend to be found in the most exposed areas, while northern elements seek more shelter. Something further will be said of this later. This type of occurrence is commonly found elsewhere; for example, Peronian elements appear in Victorian bay faunas. The greatest influence in the long run on the shore fauna must be an ecological one, for the effect of change on metabolism is apt to be profound, and it seems a long recognised factor that it is easier for a shore animal to migrate north rather than south.

Another vexed question is that of the traces of New Zealand elements in the Tasmanian mollusca fauna. No evidence of direct communication between the two countries is forthcoming. There is the possibility that ocean currents were or are responsible. Or that a northward migration during a Pleistocene "shallow sea" met and mingled with a New Zealand migration in part, subsequently returning south to new shores. These possibilities are far from satisfactory, and do not take into account the land and freshwater faunal resemblances, although these could have branched from a "southern origin." No single factor will explain the difficulties of such affinities, and any evidence is certainly clouded by past migrations and present ecology.

The immediate problem then is the full interpretation of the ecology of the shore faunas. Thus students of the mollusca not taking all the evidence into account are apt to be led astray. Ashby (1926) proposed to alter Hedley's zoo-geographical regions on the basis of his chiton studies which were not sufficient alone, but he did realise individuality in the Tasmanian fauna.

The present work does not pretend to provide answers to the many problems involved, but is merely a study of the Tasmanian intertidal mollusca found on the various types of shoreline, together with some of the affinities with other parts of the Australian coast. The work is based on notes made during tours of the southern, eastern, northern, and western coasts, from the Derwent River Estuary to Marawah. The writer has also had the benefit of studying mollusca collected by Dr. Eric Guiler in southern Tasmania and from Trial Harbour on the west coast. Other references, duly acknowledged, are drawn from the literature. The writer is grateful to Dr. Guiler for his continued interest in the writer's work.

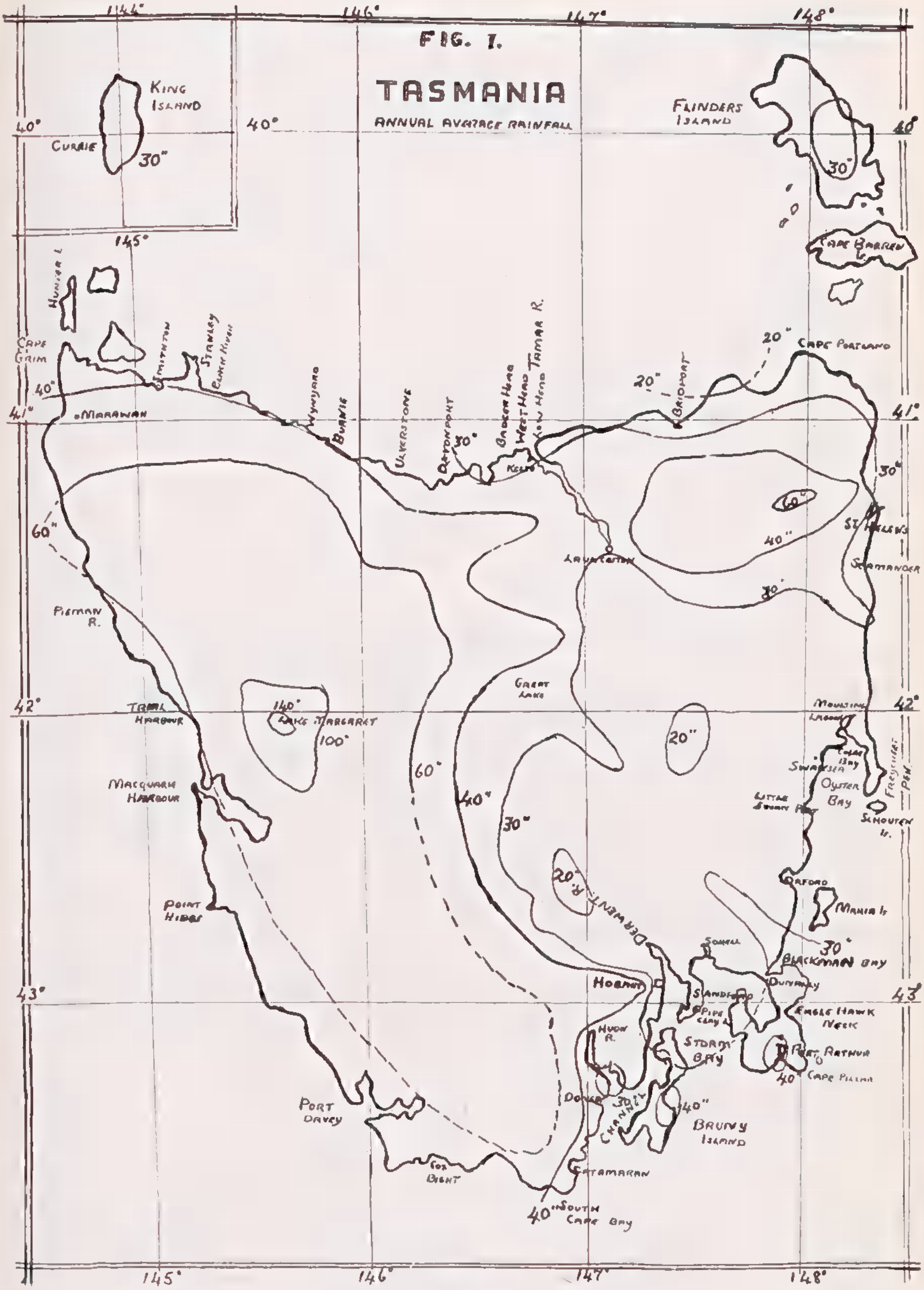
THE ENVIRONMENT

Tides.

Guiler (1950) described the greatest rise of tide in the Derwent Estuary (south Tasmania) as of the order of three feet six inches and the greatest fall of the order of five feet. On the north coast the maximum tidal range is of the order of nine to ten feet. The east coast and the west coast of Tasmania are comparable with the southern coast in the matter of tidal range. The essential difference lies in the fact of wave exposure on the oceanic coasts, where wave action and spray may extend the "intertidal" habitat very much beyond a presumed normal on which nomenclature is based.

Geology.

The general geology of Tasmania has been described by Nye and Blake (1938), who make general references to the coastline. The following remarks are based largely on the writer's own observations, substantiated by numerous references to the available literature. Much of the rocky shoreline of Tasmania consists of the highly resistant dolerite. In some places, principally in the north, more recent extrusive lavas are present. Ancient resistant metamorphosed sediments form headlands in certain places, while massive granites appear in others. Thus a great deal of the rocky shore is highly resistant to wave action and the environment is apt to be jagged and boulder strewn, with little in the nature of platform surfaces. In certain areas Peruvian mudstones and fillites outcrop on the shore, and in such places erosion has been more extensive, with the formation of platforms, caves and blowholes. Bays are frequently cut in soft Triassic sandstones, and there are stretches of emergent coast with sandy beaches backed by dunes, behind which lagoons are impounded—notably on the East coast. Flandrian drowning has contributed to the formation of estuaries, while emergence has provided mud flat and salt marsh in certain bays and lagoons.



Text figure 1:

Locality map and Isohyets.

Climate.

On the basis of Thornthwaite's system (Gentilli 1948), the climate of Tasmania may be summarised as follows. There is a sub-humid warm climate in the north, east, and midlands. There is a sub-humid cool climate in the south-east and central eastern midlands. There is a super-humid cool climate in the west, with a small area of cold climate on the Central Plateau. A map (Text fig. 1) has been prepared from information provided by the Weather Bureau, Hobart, showing the isohyets of rainfall which relate particularly to coastal climate. Certain inland centres of high and low rainfall are also included to make the above summary clear. The western high rainfall materially affects estuaries, and even bay waters in that area, by reason of the volume of water in the rivers. This is not true on the east coast, but a large volume of fresh water may enter bays and estuaries during winter floods. The headwaters of the Derwent and Tamar are in high rainfall areas, but the length of these rivers modifies the effect on estuaries.

The extent of dessication due to exposure to the heat of the sun is greater in the east and north where there are more cloudless days than on the west coast. Tasmania is in the path of the Westerlies, with occasional Antarctic influences. Hence greater turbulence may be expected on western shores, but all exposed coasts except those in Bass Strait are subject to oceanic conditions with gale force winds. Nevertheless, storms of western or eastern origin may concentrate in Bass Strait and produce gales with considerable wave action, and this is a common winter occurrence. The centres of the principal low pressure systems appear to pass just to the south of Tasmania during the winter. Other systems may develop in the Bass Strait region or to the east, while occasional tropical systems reach far enough south to influence the north and east. Other factors involved include the topography of the island and the ocean currents. Thus the warm East Australian current no doubt assists other factors in producing a considerably milder climate in the north-east of the State. There is apparently some westerly drift into Bass Strait, which will ensure western influences along the north. But the eastern influences are very strong, and Dannevig (1915) envisaged a building up of the waters in central areas. Bennett and Pope (1953) found that there is some westerly predominence.

Table 1 shows the maximum, minimum and average mean temperatures, and the highest and lowest recorded temperatures for certain coastal stations in Tasmania.

Table 1—Temperatures at Coastal Stations.

	Temperatures in degrees fahrenheit.				
Locality	Maximum mean	Minimum mean	Highest recorded	Lowest recorded	Average mean
Burnie	59	38	85	30	48
Cape Bruni	57.9	47.3	99	28	52.6
Cape Sorell	58.7	49.2	90	30	53.9
Currie	61.1	49.8	96	30	55.4
Eddystone Point	61.7	49.6	96	30	55.7
Hobart	61.9	46.8	—	—	54.3
Hythe	59.8	44.1	—	—	41.9†

Kettering	59.3	42	—	—	50.6
Low Head	60.1	49.1	84.6	27	54.6
Maatsuyker Is.	56.7	47.1	94	31	51.9
Marawah*	58.4	46.1	—	—	52.3
St. Helens	63.9	44.4	103	20	54.1
Stanley	60.2	48.5	93	20	54.3
Swansea	63.2	45.6	104.1	24	54.4
Zeehan	59.1	43.5	99.2	19.4	51.3

† The low average mean record for Hythe probably is an error.

* Marawah is some miles inland from the West Coast.

Table 1 is based on figures kindly provided by the Weather Bureau at Hobart. Certain sea temperature records are given by Guiler (1950) and Kershaw (1957), while Bennett and Pope (1953) give a table of temperatures from readings by H.D.M.S. "Galathea" in "South-eastern Australian waters." The variability of rainfall in Tasmania is discussed by Scott (1956), who remarks the greater variability in the east which is significant in the final analysis of differences between east and west, and in the conditions experienced in the east and north-east.

Intertidal Classification.

There has been some controversy on the matter of classification of various parts of the shore. Hence the Tasmanian work of Guiler (1950, 1953) is followed for two reasons—firstly for the sake of uniformity, and secondly because the writer has found it in general sound in application. The zones recognised by Guiler are "the Supralittoral," "the Midlittoral" and "the Infralittoral." The Supralittoral and the Midlittoral are separated by a "Supralittoral Fringe," the highest area reached by spring tides. The Midlittoral zone is the normal tidal area. The Midlittoral and the Infralittoral are separated by the "Infralittoral Fringe," which is the region exposed only at extreme low spring tides. The flora and fauna of these areas have sufficiently distinctive features to enable their being recognised in the field. Guiler has recommended that for further subdivision of these zones, the term "Belts" be used, each belt to be distinguished by its characteristic plant or animal, in general the dominent species of that belt, or part of the shore. These "parts" of the shore are well recognised, but different terms have sometimes been used in defining them. The writer has no intention of discussing the matter and hereinafter the above scheme will be used. The nomenclature is also here applied to sandy shores as far as possible in order to avoid terms such as "midtide" which convey little without detailed knowledge of a particular shoreline.

A different mode of classification has been used by Guiler (1951) for a lagoon, based on the presence of a belt of the sea-grass *Zostera*. Thus there are three zones, the "Supra-*Zostera*," the "*Zostera*," and the "Infra-*Zostera*." These are subdivided into "Belts." This has come in for some criticism, but the writer has found it useful in sheltered waters in northern Tasmanian localities, and it is here used where desirable. It is possible to correlate this scheme with rocky shore zones in some places.

Intertidal Belts.

1. *The Supralittoral and the Supralittoral Fringe.*

As pointed out by Guiler (1953) and Cribb (1954) a belt of yellow, orange and grey lichens is often conspicuous on Tasmanian coasts, notably where there is considerable spray. In the writer's opinion, this is as true of the north coast as the above authors found it true of southern and eastern coasts. The first molluscs to be encountered on the exposed shore are found immediately below this belt, in the Infralittoral Fringe. *Melaraphe unifasciata* (Gray) and *Melaraphe praetermissa* (May) here form a belt which is only absent when *M. unifasciata* cannot obtain a hold or the habitat is virtually absent. On the sandy ocean shore there is no equivalent mollusc, but in sheltered areas *Ophicardelus ornatus* (Ferussac) and *Bembicium auratum* (Quoy and Gainmard) (*qv.* Cotton 1956 *b.*) may be present on rocky shores, and *Salinator solida* (Von Martens) on mud flats. *Ophicardelus* is only present in certain very sheltered localities. *Bembicium* commonly replaces *Melaraphe* as a belt forming species in sheltered areas, but is probably not found so high on the shore as the Infralittoral Fringe, and therefore is not strictly equivalent to *Melaraphe*. On the exposed shore *Bembicium nanum* (Lamarck) occurs throughout the Midlittoral where conditions are suitable, and does not compete with *Melaraphe*. *Melaraphe unifasciata* may occur on sheltered shores, but frequently is small and few in number of individuals. *M. praetermissa* appears to favour more moisture in the form of increased spray or tiny pools in which the writer has observed it to congregate. This latter species extends to Victoria, whereas *M. unifasciata* is present as far north as southern Queensland, (Endean, Kenny and Stephenson 1956).

2. *The Midlittoral.*

On the North Coast a *Melanerita* Belt is referred to by Kershaw (1957), in which *Melanerita melanotragus* (Smith) is in noticeable numbers associated with *Bembicium nanum* (Lamarck), *Austrocochlea constricta* (Lamarck) and *A. concamerata* (Wood), these latter species usually seeking shelter. *Melanerita* is only present on coasts with some degree of exposure; it is only common on the North Coast, but is present on the East Coast and the West Coast at least as far south as Trial Harbour. The northern occurence is more nearly equivalent to that of the mainland of Australia than other parts of Tasmania. On sheltered shores *Bembicium auratum* is the dominent species of this area, although on certain partly exposed shores in the bays or estuaries such as north of Kelso in the Tamar Estuary it is reduced to an associate of *Austrocochlea obtusa* (Dillwyn) in its smaller estuarine form.

The Barnacle Belt is next present on most rocky shores, though sometimes reduced by competition with mussels. Juvenile *Melaraphe* may be found in this area. *Bembicium*, *Austrocochlea spp.* and *Melanerita* are found over most of the shore. The barnacles may be succeeded or, as inferred above, almost replaced by Mussel Belts, as at Bridport, where *Modiolus pulex* (Lamarck) competes very strongly with the barnacles, or again, preceded as is often the case on the East Coast by *Austromytilus rostratus* (Dunker) (*olim Brachyodontes*, Laseron 1956). In the sheltered West Arm of the Tamar River the competition is reduced, as *Modiolus* *pulex* tends to prefer rough surfaces, while the barnacles, *Elminius modestus* (Darwin), occupy smooth surfaces, but in any case the sheets are not continuous, probably due in part to influxes of muddy sand, or mud.

On the exposed Tasmanian coasts there is commonly present a Patelloid Belt occupied principally by *Cellana solida* (Blainville) and *Siphonaria app.* with other limpets. This belt is present at West Head on the North Coast, but the ocean coast belt is the more populous. *Cellana solida* occurs on semi-exposed coasts such as Oyster Bay and even in relatively sheltered bays such as Coles Bay at the head of Oyster Bay (East Coast), but not on sheltered estuarine shores. The sheltered shore has no Patelloid Belt as such, but the equivalent area tends to be dominated by *Siphonaria diemenensis* Quoy and Gaimard, but there are associates such as *Bembicium* and sometimes the pulmonate slug, *Onchidella patelloides* (Quoy and Gaimard), a species found in considerable numbers in the West Arm, Tamar River, but not apparently in the south. On other coasts, semi-sheltered but not estuarine, particularly in the south, *Mytilus planulatus* Lamarck forms an important belt, much as used to be observable at the head of Port Phillip Bay in Victoria.

On most types of coast there is present a *Galeolaria* Belt consisting of the tubes of the serpulid worm *Galeolaria caespitosa* Lamarck, which encrusts the rocks. The encrustation is sometimes as a thin veneer, as on the most exposed parts of West Head studied by the writer, or reaching a thickness of three or four inches or more in favoured sheltered places. *Galeolaria*, however, does not form a belt or is entirely absent in fully exposed localities in Tasmania, unlike New South Wales where it apparently favours surf. Guiler (1954) has drawn attention to this point. Hence this belt is only of significance as a shelter for molluscs on coasts having various degrees of shelter. Both Guiler (*loc. cit.*) and the writer have noticed that *Galeolaria* appears to have periods of heavy mortality, when whole clumps break off and the population is reduced to an insignificant unit from which slow recuperation follows. It is probable that the sheltering population of molluscs, worms, etc., also suffer as a result. These include *Montfortula spp.*, juvenile *Sypharochiton maugeanus* Iredale and May, *Kellia australis* (Lamarck), *Lepsithais vinosa* (Lamarck) (preying on the others), and sometimes *Onchidella patelloides* amongst many others. In this area with increase of exposure the limpet, *Patelloida alticostata* (Angas) is important, and if often encrusted with the tubes.

In the vicinity of *Galeolaria* there may be a belt of the necklace weed *Hormosira banksii* (Turn.) Decaisne which provides shelter for many gastropods including the limpet *Chiazacmea flammea* (Quoy and Gaimard) in one of its forms. *Bembicium*, *Austrocochlea* (*Fractamilla*) *concamerata* (Wood), A. (*Chlorodiloma*) *adelaidae* (Philippi) and lower down A. (C.) *odontis* (Wood) are the common species, and these may have associated the sea star, *Patiriella exigua* (Lamarck), etc. On the North Coast shores *Modiolus pulex* is often reduced to a modified belt of small individuals, closely packed over small areas with barnacles, *Chamaesipho columna* (Spengler) and *Tetraclita purpurascens* (Wood) in association.

The lowest Belt of the Midlittoral is that occupied by Coralline algae, which often form a turf on exposed shores. The mollusc population rapidly increases in variety and numbers, and many appear under stones, including chitons, particularly *Ischnochiton elongatus* (Blainville) and *Ischnoradsia evanida* (Sowerby), with *Poneroplax albida* (Blainville) or *P. costata* (Blainville) according to the degree of exposure. In Southern areas the New Zealand *Amaurochiton glaucus* (Gray) is slowly spreading, and is noticeable in many places. Common molluscs are *Austrocochlea, Cominella, Dicathais, Pleuroploca, Micrastraea aurea* (Jonas), *Notohaliotis ruber* (Leach), *Forelepas tasmaniae* (Sowerby), *Patellanax, Notoacmea* (higher on sheltered shores), *Subninella undulata* (Solander), and many others. The species have been omitted in several cases as some vary with exposure, which will be clear later in this work.

Adjacent to the rocky shore of the West Arm, but not on the soft muds or sands unless there is rock surface just underneath, a great deal of Midlittoral is occupied by *Velacumantus australis* (Quoy and Gaimard), (Family Cerithidae). This mollusc is also present in such sheltered places as Port Arthur (Cribb, 1954) and Pipe Clay Lagoon (Guiler, 1951 *a.*), but the writer has not seen anything equivalent to the development in the West Arm. The species is not present as high as the *Bembicium* Belt usually, and is also only a minor constituent of more exposed faunas. It is not present on exposed coasts. It is usually absent except in exceptional conditions on parts of the shore where a *Zostera* habitat is present.

The *Zostera* Belt appears to extend from a point in the Barnacle Belt to a point in the *Galeolaria* Belt apparently central. The upper limit appears to vary with local conditions, and the writer has noticed it almost reaching the *Bembicium* Belt. The associated fauna is largely bivalves but with certain important gastropods. Stones lying on the shore or adjacent rock surfaces have in some areas enabled some correlation to be made between belts on the *Zostera* type of shore and rocky shore belts, but these are not accurate, hence the ill-defined extent of the *Zostera* Belt proper, indicated above. There are two types of shore upon which *Zostera* may appear. These are the sandy or muddy-sandy lagoon (e.g., Pipe Clay Lagoon) or estuarine inlet (e.g., West Arm, Tamar River) enjoying maximum shelter, and the sheltered bay or sandy estuarine shore. The best example of the latter type with which the author is familiar is the sandy shore north of Kelso, and Kelso Bay a little south of Kelso, both localities being in the Tamar River and hence estaurine. The West Arm, Kelso Bay, and the sandy shore north of Kelso have increased exposure in each case, but many molluscs are common to each. The first essential difference lies in the numbers of individuals of certain species, and secondly some species which occur outside the river mouth find a place north of Kelso, but not in West Arm, while some are peculiar to West Arm and/or Kelso Bay, but do not reach the river mouth. Other shores where *Zostera* is of note spring to mind, but these serve as examples, while in D'Entrecastreau Channel *Zostera* passes below low tide and is of interest in relation to the proximity of the Scallop beds, but is outside the scope of this work.

In other parts of Australia a Zosteretum is formed by this plant, in which populations of molluscs and other animals find shelter. This is hardly the case in Tasmania, but the writer has found small areas sheltering numbers of animals which perhaps may be referred to as a modified form of Zosteretum.

As already noted, the Supralittoral Fringe on the mud flat is commonly occupied by *Salinator solida* (Von Martens) and this species will even occur where there is a fair admixture of sand, as on the sheltered shore below the township of Stanley, north Tasmania. But it appears absent on the sandy shore north of Kelso. If there are stones present, the Midlittoral may be commenced by *Bembicium* and *Austrocochlea* as at Kelso, or *Bembicium* and *Ophicardelus* as in parts of the West Arm, the latter shells being in the Supralittoral, or S.-L. Fringe, otherwise sand or mud dwellers are encountered.

Provided there is sufficiently firm substratum, *Bembicium* will find a place and may form a Belt. It has done so in Pipe Clay Lagoon (Guiler 1951) and this will be used as a starting point. The following Belt is that formed by *Eubittium lawleyanum* (Crosse), which is very extensive in Pipe Clay Lagoon, much reduced at Kelso and other parts of the Tamar, although the number of individuals to the square foot is much the same. The Belt in the West Arm is much reduced where it occurs. The substratum here is muddier and the shore steeper, so that the amount of the shore exposed is a function of the tidal range and not the shallow depth as at Pipe Clay.

Assiminea brazieri (Tenison-Woods) is a localized dominant in the areas under discussion and does not form a belt. The next Belt then is that formed by *Anapella pinguis* (Crosse and Fischer) in Pipe Clay Lagoon. In the West Arm this Belt is very narrow and often absent. It is succeeded by pockets of *Katelysia peroni* (Lamarck) in West Arm, this species being virtually as plentiful as *Anapella*. *Katelysia spp.* are recorded from Pipe Clay Lagoon by Guiler (*loc. cit.*) under the name "*Marcia*." *Anapella pinguis* is more plentiful in Kelso Bay, but both this species and *Katelysia peroni* may only be described as present at Kelso-north. Here as in Pipe Clay *Katelysia scalarina* (Lamarck) is relatively common at this point.

Zostera nana now forms a Belt which is also the *Zostera* Zone of Guiler's Lagoon classification. In Pipe Clay the compact beds do not favour the burrowing bivalves, and this is true of the West Arm, but not so of the Kelso localities. *Macoma deltoidalis* (Lamarck) and *Katelysia scalarina* (Lamarck) are both found burrowing in the beds, while in firm sand where *Zostera* is sparse at Kelso-north, *Austromytilus erosus* (Lamarck) is found anchored in the substratum by the byssus to firm objects. Guiler records *Austromytilus rostratus* (Dunker) from the *Zostera* of Pipe Clay, and he has found this species at Trial Harbour on the West Coast, and *A. erosus* in a sheltered area at Fisher Island at the same locality.

In the Tamar localities the dominent animal of the *Zostera* or part thereof is *Salinator fragilis* (Lamarck), but is only among those present in Pipe Clay. In West Arm it is plentiful throughout the *Zostera* and often in other places. In Kelso Bay *Austrocochlea obtusa* is co-dominant, while at Kelso-north *Salinator fragilis* is only dominent on the shoreward edge of the *Zostera* belt. Over the remainder of the Belt there is a varied population, including *Austrocochlea obtusa* and *A. constricta, Cominella lineolata* and *C. acutinodosa, Parcanassa pauperata* (Lamarck), *Assiminea brazieri,* and *Cacozeliana granarium* (Kiener). The crab *Paragrapsus quadridentatus* (Milne Edwards) is also present. In the West Arm there is *Paragrapsus grimardii* (Milne Edwards) and *Mictyris platycheles* Milne Edwards, as at Pipe Clay Lagoon.

In the Infra-*Zostera* Zone, *Katelysia corrugata* is recorded by Guiler as the first dominant for Pipe Clay. This species is not present in the northern localities, but *Katelysia scalarina* is present at this point, though not in numbers. At Kelso-north it is a much more robust shell than in other areas, and resembles more nearly the type of shell found on the mainland. At Kelso-north *Cacozeliana granarium* became very numerous on the edge of the *Zostera* bed, but close inspection revealed that many shells were dead.

Austrocochlea obtusa (Dillwyn) is then dominent in Pipe Clay to the Lagoon bottom. In West Arm this species is present at a similar level, as also at Kelso. In Kelso Bay it is uniform throughout the shore, while at Kelso-north it appears best developed in the *Zostera* Belt. In these estuarine waters there are two forms, the smaller of which is generally found on the higher parts of the shore. In West Arm a large, robust form lives at extreme low tide and only occasionally reaches higher parts of the shore and is never in numbers. In East Coast bays this robust form may be the only one present, and is larger still. A small form is present in Pipe Clay Lagoon.

In Kelso Bay the bivalve *Laternula creccina* (Reeve) may appear at extreme low tide, while in West Arm it is replaced by *Laternula tasmanica* (Reeve) and this is equivalent to *Laternula recta* (Reeve) of the Mainland.

The Sandy Beach.

The number of molluscs actually living on the sandy beach is small, and many are only "exposed" at extreme low tide, but are frequently washed in shore alive by heavy seas. The first species which become obvious live in the Midlittoral, in an area approximately equivalent to the Zostera Zone of more sheltered shores. In point of fact, one of these species, *Uber conicum*, is found alive on the *Zostera*, as for example at Kelso-north. Universal on sandy shores, and probably in general, dominent is the bivalve *Amphidesma augusta* (Reeve), so far as the north and east are concerned, but in Sandy Bay, and in the vicinity of Dunally in the south, *Amphidesma erycinaea* (Lamarck) appears to replace it so far as is known to the writer. Cotton and Godfrey (1938) observe that Flindersian examples are smaller than Peronian, and this applies in Tasmania, in that North Coast examples are smaller than those from East Coast localities. *Uber conicum* (Lamarck) is found in a similar position on most sandy shores examined by the writer, exposed and semi-exposed, but did not appear on the most exposed beach on the East Coast visited, a place near Scamander, but as a heavy sea was running accurate observations were difficult.

Living rather lower and apparently universal is the Venerid bivalve, *Placamen placidum* (Philippi). All localities visited on the north, east and south yielded examples alive. However, none were obtained at Marawah on the West Coast, but here again results were hampered by heavy seas, and few bivalves were obtained. *Katelysia scalarina* is generally found, and at Sandy Bay near Hobart is a robust shell associated with *K. corrugata*. In the north *K. peroni* appears, but does not appear to favour much exposure, and is essentially an estuarine shell. *Anapella pinguis* is common and especially plentiful in East Coast sheltered lagoons. *Notospisula trigonella* may also be observed. Other bivalves live in the Infralittoral

Fringe or below, and will be tabulated later, but some may now be mentioned. Very common on the East Coast is *Glycymeris* (*striatularis*) *suspectus* Iredale. This shell is rarely found alive and is not strictly intertidal, but is referred to here as it is especially characteristic of the East Coast. Similarly, *Tawera gallinula* (Lamarck) is very common on the East Coast, but is also found on most other beaches. *Flavomala biradiata* (Wood) is best developed with some shelter, though it is found on the exposed shores of the North Coast also. However, this species does not appear to reach beyond semi-exposed Eastern shores, such as Oyster Bay. *Electroma georgiana* (Quoy and Gaimard) is commonly found attached to weed or stones of the Infralittoral Fringe adjacent to sandy shores. An important gastropod of the North and East which should be mentioned is the well-known *Phasianella australis* (Gmelin).

3. *The Infralittoral Fringe.*

For convenience some remarks have already been made concerning this part of the sandy shore; it is now proposed to return to the rocky shore. In this area Ascidians may form a belt, while the bulk of the algal flora begins here, and provides the most notable cover for molluscs. Many also find shelter beneath stones. The fauna of this area cannot be dealt with exhaustively in this work, and only a few of the more obvious will be mentioned here. Numerous shells have been collected and are still being sorted and studied.

An important shell is *Notohaliotis ruber* (Leach), which May (1923) records from "East and South." However, it is present at West Head and elsewhere in the North. *Sabia conica* (Schumacher) is frequently found attached to this and other shells, also in semi-sheltered areas. *Mesoclanculus plebejus* (Philippi) is often found under the same stones as *Notohaliotis*, while *Macroclanculus undatus* (Lamarck) and *Euriclanculus limbatus* (Quoy and Gaimard) are more common in the East than the North; *M. plebejus* is found everywhere. Also encountered on stones are *Rissoina fasciata* Adams, *Serpulorbis sipho* (Lamarck) (semi-sheltered), *Ellatrivia merces* (Iredale), *Marginella pygmaeoides* Singleton, *Floraconus anemone* (Lamarck), *F. peronianus* Iredale (East Coast), *Austrodrillia beraudiana* (Crosse) (also on the West Coast), *Zemitrella tayloriana* (Reeve), *Z. lincolnensis* (Reeve), *Z. vincta* (Tate), *Z. acuminata* (Menke) (North and West), *Syrnola aurantiaca* (Angas), *Eulima auger* Angas (both North). Most of these shells occur in both exposed and semi-exposed localities, but the full degree of exposure is not clear in all cases. A Bass Strait shell, *Galfridus eburneus* (Petterd) has been taken by Guiler at Point Puer in the South. *Dicathais textiliosa* (Lamarck) is widespread, particularly in the North and West, favouring exposure and often higher on the shore. The Peronian *Dicathais orbita* (Gmelin) occurs on the East Coast, and occasionally on the North Coast, but not often west of the Bridport-Tamar area. May used this species for his figure (1923, Pl. 11, fig. 15). *Ischnochiton elongatus* is commonly met. *Ischnoradsia evanida* (Sowerby) is very plentiful at exposed Northern localities. *Acanthochiton sueurii* (Blainville) occurs in sheltered places in West, North and South. Other gastropods are *Zella bedommei* (Petterd) (Coles Bay), *Fossarina petterdi* (Crosse), (South and Point Puer), and *Fossarina* *legrandi* Petterd (West and South). Some of these shells live in the algae. Others better known from various algal species are *Thalotia conica* (Gray) (very common on the sheltered shore at Circular Head, also West Head, etc.), *Phasianotrochus irrisodontes* (Quoy and Gaimard), *P. eximius* (Perry) (also on the exposed Kelp weed), *Cantharidella tiberiana* (Crosse), and in Kelp roots *Scissurella ornata* May and *Scissurona rosea* (Hedley). These last two are rarely exposed, except by very low calm seas.

A number of gastropods occur on sandy shores in the Infralittoral Fringe region, some rather rarely. The most plentiful is *Bankivia fasciata* (Menke), which is washed to this position from weed. This shell is much larger on the East Coast than elsewhere. *Ectosinum zonale* (Quoy and Gaimard) is a true sand dweller, while others are *Marginella formicula* Lamarck, *M. tasmanica* Tenison-Woods, *Alocospira marginata* (Lamarck), *A. oblonga* (Sowerby), *Baryspira petterdi* (Tate), *Quibulla tenuissimma* (Sowerby), *Philine angasi* (Crosse and Fischer). Others are found alive but are accidental to this area.

It cannot be said that any of the shells of the Infralittoral Fringe have special significance except as part of the general ecology, for on rocky shores they are dependent on other dominants for shelter, though their own numbers may be considerable. Young *Ostrea angasi* may occupy this position in some numbers in sheltered waters. For example, this species is an important constituent of the edge of a mudstone platform in the West Arm, Tamar River. Sand dwellers of this area are more often below tide levels than above. As with the Olividae, they rarely approach the shore above tide level, being sand bar dwellers. The number and variety of species, though less than in northern States, are probably more significant than realised by comparison with other rocky shore dwellers, because the latter are so obvious and numerous. In this work, concern is more for the constituent individuals than for the zones and belts which serve their purpose as guides. It is, therefore, a pity that it is not possible yet to present a full census of them.

4. *The Patelloid Belt Fauna.*

Brief mention only has been made of the limpet and limpet-like molluscs, but fuller discussion is merited. *Cellana solida* is the characteristic limpet of the Patelloid Belt. It has been thought that the South Australian *Cellana rubraurantica* (Blainville) occurred in Tasmania, but Macpherson (1955) has shown that *C. rubraurantica* is a synonym of *C. solida*. Iredale (1924) assigned the name *C. solida* to the East Coast shell and expressed curiosity concerning the species on the North Coast. However, there is only one species of *Cellana* on all Tasmanian shores of sufficient exposure. *Cellana tramoserica* (Sowerby) occurs elsewhere, as discussed below. Confusion concerning *C. solida* probably first arose owing to the variability of the sculpture. Examination of numerous specimens shows that more shells with narrow ribs relatively closely spaced occur on the East Coast than on the North Coast, where broader ribs tend to predominate. On the East Coast, shells with narrowest ribs occur in sheltered places, such as Coles Bay. However, series from many localities indicate that variation is always present in some degree and has no specific importance. True races cannot be recognised at present. Another confusing point is that young shells can be taken for a different species. Macpherson (*loc. cit.*) has pointed out that Blainville actually described *C. solida* from the young shell.

No form of *C. solida* has ribs so narrow as *C. tramoserica*, although in the case of stunted shells some doubt could arise at first sight. *Cellana tramoserica* (Sowerby) is at the southern limit of its range on Tasmania's east coast, and, as May (1923) has observed, it is very much smaller. In appearance it is none the less typical (though only a minor constituent of the fauna), with only an occasional specimen seen on the North Coast and probably absent altogether on West and South. Its range in Tasmania may be put down as East and North-east. No large shell of this species has been seen in Tasmania, and all large eroded *Cellana* may be identified in the field without hesitation as *C. solida* (Blainville).

Very little has yet been published concerning the West Coast limpets. So far as has been observed, the essential difference between this coast and the East Coast lies in the number of individuals rather than species, so that it is thought that the Patelloid Belt is much more marked on the West Coast. The writer has seen the limpets collected by Guiler on the West Coast at Trial Harbour, but information as to their distribution has not yet been published. Near Marawah, the writer was unable to collect many live shells due to rough seas, although a large series of dead specimens was collected for comparison. At Trial Harbour, Dr. Guiler found *Cellana solida, Patellanax peroni* (including the form *P. squamifera*), *Patelloida victoriana, Patellanax chapmani, Patelloida latistrigata,* and at Fisher Island *Patelloida alticostata* and *Patellanax chapmani.* In the South, Dr. Guiler has taken *Patelloida latistrigata, Patelloida alticostata, Cellana solida,* and *Patellanax peroni.* Other species would be difficult to reach owing to the constantly surging seas. All the species mentioned above have been collected by the writer on the East Coast. On the North Coast he has collected *Cellana solida, Patelloida alticostata, Patellanax chapmani, Patelloida latistrigata,* but not *Patellanax peroni.* However, two dead specimens were taken on the west side of the Nut, Stanley.

Patellanax peroni has its habitat in the Infralittoral Fringe of the ocean rocky shores. *Patellanax chapmani,* on the other hand, occurs in areas with some degree of shelter, such as that already referred to as Kelso-north. There is some indication that *Patelloida alticostata* seeks some shelter in the West, being absent from exposed places. This may be true in the far South, but it is present in exposed places elsewhere. Dr. Guiler took it at Point Puer, although he does not refer to it when discussing Eagle Hawk Neck fauna. It should be noted that the names used are not necessarily the same as those used by Guiler, who in his earlier work followed May (1923). There appears to be some variation in the ornament of this species. *Patelloida victoriana* is especially common at Marawah on the West Coast, and may be much less important on the East Coast.

Limpets which Macpherson (*loc. cit.*) places in the family Acmaeidae (family Lotiidae in Kershaw 1955) have their habitat in the Midlittoral in sheltered areas, and in the Patelloid Belt the Infralittoral Fringe in exposed places. *Notoacmea petterdi* (Tenison-Woods) does occur at higher levels, however, and its range so far as is known to the writer is East Coast

(Bicheno), north (one specimen, West Head), North-east and West (Trial Harbour, Guiler). Macpherson (1955) indicates North-west Tasmania, although her map shows the distribution extending to a point south of Hobart. Its extension to Trial Harbour is particularly interesting, as its main distribution is Peronian.

Notoacmea scabrilirata (Angas) is found in most places which are sheltered or semi-sheltered. It is gregarious under stones, but individuals are found over most of the Midlittoral below the *Bembicium* Belt. It may be most common at lower levels, but in the West Arm at any rate, it cannot be said to be peculiar to any defined belt. In more exposed places, a limpet for which the writer uses the name *Conacmea subundulata* (Angas) is found most plentifully on bare surfaces just below the *Galeolaria* Belt. May (1923) says its habitat is estuaries and inlets, but the writer has not found it in such places in the north. Guiler, however, has found *Conacmea corrosa* Oliver in sheltered places where May also found it. *Conacmea subundulata* also appeared at Trial Harbour, and, in addition, *Notoacmaea mayi* (May). This latter species appears to have more exposure tolerance than the others. Dr. Guiler found it at Freycinet Peninsular where there is perhaps somewhat less exposure than at Trial Harbour (although one is not in a position to make comparisons), and also in the sheltered southern Barnes Bay. It seems likely that the species can withstand a fairly wide range of conditions. Also at Trial Harbour is found a small *Chiazacmea* species. At present this genus is best known in somewhat sheltered places in Tasmania by the species *Chiazacmea flammea* (Quoy and Gaimard), which seems absent from both oceanic and very sheltered coasts. In the north a variety, or subspecies, occurs at Kelso and at West Head, as well as elsewhere, for which one has continued to use the name *Chiazacmea mixta* (Reeve), although this matter may need further investigation. At Kelso-north in the estuary it lives at a low level, apparently rarely above the Infralittoral Fringe, but while it also lives in that position at West Head, it has appeared in the shelter of *Hormosira banksii* in small pools at the highest parts of the Patelloid Belt. Another subspecies, *Chiazacmea mimula* (Iredale), has been recorded from Blackman's Bay, but the writer has not seen a specimen.

The next group of the Patelloid Belt consists of species of the family Siphonariidae. From an ecological point of view it is probably best to use the generic name "*Siphonaria*" for these, as the taxonomy has been somewhat confused. Australian workers (Iredale 1940, McAlpine 1952) introduced new generic names subdividing the group, but Hubendick (1946, 1955) states that these (i.e., those with which we are here concerned) can only represent sections of the "subgenus" *Siphonaria*. The writer, however, has used these so-called genera as sub-genera of *Siphonaria*, and this would not have mattered seriously but that one of these, *Ductosiphonaria*, has to be abandoned (Hubendick 1955). Moreover, the species belonging to *Talisiphon* Iredale are regarded by Hubendick (1946) as belonging to *Pachysiphonaria* Hubendick, to which he also allots *Siphonaria funiculata* Reeve and several South American species. On this basis, *S. tasmanica* and *S. funiculata* would be placed in the subgenus *Pachysiphonaria*, but this obviously has zoogeographical repercussions. These cannot be discussed here, but merely borne in mind. Finally, Hubendick contends that *Hudendicula* McAlpine, as already inferred above, is but a section of subgenus *Siphonaria*. Consequently *Pachysiphonaria* and *Hubendicula* cannot consistently be used on the same basis. All the Tasmanian shells would thus need to be placed in the genus *Siphonaria* if the confusion of complicated nomenclature is to avoided. The alternative is to abandon the Australian names in favour entirely of those of Hubendick. To do this would be to imply criticism of this use of these names for other Australian species, which the writer is not prepared to do, nor has he sufficient information on the Tasmanian shells to enable acceptance of Hubendick's nomenclature at present, although no criticism is here intended or implied.

Thus to aid in uniformity in Australia the writer favours, and proposes to use the genus *Siphonaria* in ecological work. The species *Siphonaria diemenensis* Quoy and Gaimard is universal in Tasmania, and there are several forms. Thus *S. dimenensis* lives on rock platforms, or large aggregations of shingle in both exposed and sheltered places. Where there are individual stones, isolated heaps, or other structures breaking up the continuity of the habitat, a form occurs closely resembling that figured as "var. *scabra*" from Port Jackson by Hubendick, but lacking the same degree of exposure tolerance. In places there are shells resembling the "var. *denticulata*" figured from the same locality (Hubendick 1946). There is a colony of "var. *scabra*" at the sheltered eastern end of the West Head, and another in what is probably the most sheltered part of the West Arm, in that the swirl of the tide does not impinge directly upon it.

Siphonaria tasmanica Tenison-Woods occurs in the entrance to the lagoon at Pipe Clay Lagoon, but this appears to be its nearest approach to a fully sheltered area. However, it also occurs in D'Entrecastreau Channel near Dover (Guiler 1952 *a*), where the shelter is considerable. It also occurs on the west side of the Nut, at Stanley, north-west Tasmania, where there is considerable exposure though not oceanic. There are certain broad resemblances between the sheltered areas in the Channel in southern Tasmania and probably other bays there, with the exposed shores of the North Coast, but the writer feels that no more significance should be attached to this than is attached to the usual tendency to find as one moves south in eastern Australia that there is a seeking out of greater shelter. *S. tasmanica* is also a constituent of the fauna at Trial Harbour, West Coast, where it is common, but less so than *S. diemenensis*. There is a subspecies, *S. tasmanica turrita* Iredale 1940, but one is unable to find evidence that this is more than a variety.

The third species, *Siphonaria funiculata* Reeve, easily recognisable by its very fine ribs, has been found in places of oceanic exposure on the East Coast. It also occurs in Oyster Bay, and young specimens were found in Coles Bay. On the North Coast it has been found at Bridport, but not elsewhere by the writer. It appears to be moderately common in the East, and probably the same may be said of the South.

NOTES ON INDIVIDUAL SPECIES.

Modiolus pulex (Lamarck).

Laseron (1956) has recently reviewed the New South Wales Mussels, and in the light of his findings it will be of interest to record here some of the writer's observations. *Modiolus pulex* is widely distributed in Tasmania and occurs at Trial Harbour. On exposed coasts, where it occurs with *Austromytilus rostratus*, it is a minor constituent of the fauna. On the North Coast, however, it comes into its own. It is on these shores the following observations were made. The most notable development of the species is that on the granite boulders at Bridport (Kershaw 1957). Here the species dominates the Midlittoral at the expense of the barnacles. In several places *Galeolaria* is also present. No doubt this occurrence is very similar to that in western Victoria and South Australia rather than anything in other parts of Tasmania. It seems possible that a mild climate with a small amount of shelter but yet considerable wave action may be a factor in accounting for the phenomenon.

On other parts of the North Coast the shells are generally very much smaller, and may be confined to a narrow band at the lowest part of the Barnacle Belt, just above the Patelloids. This is particularly noticeable at West Head (Kershaw 1957), but the shells are somewhat larger in some localities further along the North-west Coast. May (1923) has figured a shell from "brackish water estuaries" as *M. confusus* (Angas), but shells as large as this are not common, at least in North Coast localities. The shells found in the West Arm of the Tamar River, for example, are of the same size and appearance as shells from Bridport on the average. Among them, however, are occasional much larger shells of slightly different shape, which could be labelled *M. confusus*. There is not sufficient scientific evidence to substantiate the separation of an estuarine shell as a separate species. A series of forms shows reactions to their respective environments. As Laseron (*loc. cit.*) points out, these forms are not even racial. The large shells are apparently specimens which for some reason have made very vigorous growth. There is no point in retaining the name *M. confusus* in Tasmania.

Modiolus cottoni Laseron.

This is the species which the writer (1955) recorded as *M. spatula* Lamarck, but which he could not regard as satisfactory. In the writer's opinion, Lamarck used the word "spatule" in a descriptive sense without intending to name the "variety," but one is not in possession of all the facts. Iredale (1924) quoted Tate's words concerning a var. *spatula* Lamarck, and this seemed the only name available. Cotton and Godfrey (1938) and Laseron (*loc. cit.*) have also quoted Tate's words, but presumably the name has no value. As Laseron has provided a new name for shells which he states cannot be separated from eastern Tasmanian shells, it is proposed to discard *M. spatula* from the Tasmanian List in favour of Laseron's name. As it happens, the writer was fortunate enough to obtain a juvenile specimen alive on the rocks at Bridport. This situation was a small pool in the *Modiolus pulex* belt on the jagged metamorphosed Silurian series (not the granite), which make up the rocky shore at Bridport. An adult specimen was also found, but this was dead. These shells show that the species (as Laseron believes) is hirsute, and the hairs are not forked. May's (1923) figure is not a good one, and the writer's shells are not precisely identical with Laseron's figure. The differences are probably accounted for in both cases by the fact that the shells are from the North Coast, and not the East Coast. Cotton (1957) figures an hirsute South Australian shell.

Modiolus delinificus Iredale.

Laseron (*loc. cit.*) accepts this name in place of *M. albicostus* Lamarck, and it is intended to do likewise, as the type is May's shell (1923). It is mentioned here because it is found on sandy beaches (May states "many beaches"), although as the writer has not found it alive he assumes that it lives below low tide in Tasmania also. Laseron is hardly correct in confining it to ocean beaches, for one has found it in Prosser Bay, which certainly faces the Pacific, and on the North Coast, which does not. Presumably "ocean" is a pen slip for May's word "many."

Venerupis crenata Lamarck.

This is an example of a northern shell which is found in very sheltered waters in northern Tasmania. Very many examples have been studied *in situ* in the West Arm, Tamar River, and in not one instance could it be claimed that there was evidence that the mollusc had itself bored the hole in which it was found. The rock is a Permian pebbly mudstone or normal mudstone on various parts of the shore. Where pebbles have been removed by erosion, or where joints occur, the resulting cavities have been infilled with mud. In such places *Venerupis crenata* is commonly found. Distortion is common, but there are two noticeable forms of this which may be spoken of respectively as an elongate, more or less normal form, and an abbreviated form which tends to obesity.

Austrocochlea constricta (Lamarck).

There is some doubt as to the status of this species and *A. obtusa* (Dillwyn), with the suggestion that one of these may have only subspecific or varietal value. Endean, Kenny, and Stephenson (1956) have placed *A. obtusa* as a subspecies of *A. constricta*, but this seems unnecessary as *A. obtusa* has priority by several years, although *A. constricta* happens to be type species of the genus. In Tasmania these shells occupy two types of habitat, which only appear to overlap in certain places, such as the Tamar Estuary. As there is some variation throughout the group of forms sometimes included in *Austrocochlea*, it may be of interest to review the occurrence of the various species as they appear in the Tamar Estuary, and the headland, West Head, near the mouth.

West Head (see Kershaw 1957) is an exposed North Coast rocky shore. The most plentiful *Austrocochlea* is *A. constricta*, which is common on exposed Tasmanian shores, and is found over most of the shore. It appears first high in the Midlittoral, and is soon accompanied by *A.* (*Fractamilla*) *concamerata* (Wood). *Fractamilla* is now being given generic status by some. This species occurs on this part of the shore as a large shell with a prominent apex. At the foot of the Midlittoral at West Head, this form is not found alive, but another form takes its place. This second form is much smaller, and the apex is flattened, and will be termed "Form 2" for convenience. In this same part of the shore there is also found *A.* (*Chlorodiloma*) *odontis* (Wood), while perhaps in general slightly lower still, *A.* (*C.*) *adelaidae* (Philippi) is rather less common than its congener.

At Kelso-north, inside the estuary, *A. constricta* appears in small numbers well down in the Midlittoral, and may be found as far as the north end of Kelso Bay, but very rarely further, probably only accidentally. At the same time, *A. obtusa* appears on the sand flats in numbers over most of the Midlittoral. The shell found here is a small form, about half normal size, and is probably the estuarine form of the species. In Kelso Bay this form becomes very common on the *Zostera* beds. At the south end of Kelso Bay there is a small outcrop of rock. At this point the rock fauna has shown a marked alteration to sheltered forms. The prominent *Austrocochlea* is now Form 2 of *concamerata* and the shell is very similar in general appearance except that it is now normally double the size of the normal West Head individuals, and the colours differ. In these areas, *A. odontis* is also present.

In the West Arm the upper shore has the estuarine form of *A. obtusa* with numbers of smaller shells which may be juveniles, while lower on the shore are shells which are near the normal form of *A. obtusa* in Tasmania. These are not as big as the bay shells of the East Coast nor as colourful. It is interesting to note that among shells from Boat Harbour, East Coast, both forms of *A. obtusa* appear, while the large Form 2 of *A. comcamerata* appears with a smaller shell very similar to what could have been called Form 1 of this species from West Head, although there is considerable difference in size in the specimens to hand. The "normal" *A. obtusa* from Boat Harbour distinctly recalls striped New South Wales shells. At Prosser Bay *A. obtusa* grows larger still, about one inch, and has a distinctive red tinge in this sandy East Coast bay. Variation of colour and pattern are normally expected with this species, so that the only noticeable point is the general drabness of estuarine specimens. It is doubtful whether this species ever occurs in one position in Tasmania in such numbers as appear in New South Wales.

Subninella undulata (Solander).

In Tasmania this species has two forms which are interesting from an ecological point of view, as one appears to occur mostly in exposed situations, while the other favours some shelter. The exposed shell is heavier and stronger, with elevated apex, well known in Tasmania, particularly on the East Coast. The form favouring some shelter (e.g., no more than is found at Kelso-north, Tamar River) is very like the common South Australian *Subninella undulata,* but never grows so large in Tasmania as far as the writer knows. Dr. Guiler obtained this form at Trial Harbour on the West Coast.

Lepsithais vinosa (Lamarck).

It is well known that this species is variable, hence it is of interest to find that certain variations appear to occur in definite situations. The writer has found that one form occurs only in sheltered places, and another in exposed places on all coasts in Tasmania from which shells have so far been examined. Hence it has been possible to refer to an exposed form and a sheltered form in field notes. It may be that other variations will become apparent.

INTERTIDAL MOLLUSCS OF CERTAIN LOCALITIES ON TASMANIAN COASTS.

Before presenting a tabular summary of the more important species studied, the localities at which they were observed are discussed. In the list of references at the end of this paper attention is drawn to various essays by Guiler relating to southern and eastern Tasmanian localities. Reference should be made to these for details not mentioned here.

West Coast.

As Dr. Guiler's results from Trial Harbour are not published, he kindly allowed the writer to make use of his molluscan collections in this work. Brief comment on these may be made at this point. Trial Harbour is on the West Tasmanian coast, somewhat south of the Pieman River. The rocks in the vicinity include Palaeozoic granite and Cainozoic sediments. The mollusca collected indicate two types of fauna, an exposed and a semi-exposed fauna, and these were obtained at two different places. Both groups are related to faunas from other parts of Tasmania and little individuality is noticeable. There is a suggestion of Flindersian influence, which is to be expected.

There are several species additional to those found on the North Coast, but these are such as would be expected on an oceanic coast, and are mostly present on the East Coast. One point of interest is the presence of *Austromytilus rostratus* in the exposed area and *Austromytilus erosus* in the more or less sheltered area. *A. rostratus* is an ocean coast species, but *A. erosus* occurs in semi-sheltered waters in the North and sheltered water in the East. *Patellanax chapmani* (T.-Woods) occurs in both areas and is recorded from the North Coast, but appears to be absent on the East.

North Coast.

At Stanley, collections were made on the massive dolerite headland known as the Nut. The western aspect grades from semi-exposed to exposed, with considerable wave action. Thus *Melaraphe* is hardly present as a belt at first, but becomes increasingly important until it is well developed over a considerable distance, particularly on vertical rock faces furthest out on the headland. There is a suggestion of relationship to the fauna of more exposed coasts with the presence of *Siphonaria tasmanica* and *Notoacmea petterdi*, the former absent and the latter rather rare further east on the North Coast. *Modiolus pulex* is not particularly well developed, but was found to be very plentiful near Wynyard further east. On the eastern aspect of the Nut, the exposure grades into much more shelter, and muddy flats occur with *Salinator solida* and *Anapella pinguis*, followed by scores of the little soldier crab *Mictyris platycheles*. East of this point a wide sandy beach develops with appropriate fauna. The North Coast appears to be distinguished by the presence of such species as *Uber aulacoglossa* (Naticidae), *Laternula creccina* (Laternulidae), *Eucrassatella kingicola* (Crassatellidae), *Venerupis galactites* (Veneridae), *Amphidesma nitida* (where more shelter), and these appear to be absent on other sandy shores.

West Head has been described by the writer (1957), and Green's Beach east of the headland is similar to that at Stanley, except that *Eucrassatella kingicola* may not be present.

One has already referred frequently to localities within the Tamar River. These grade from semi-exposure to sheltered to very sheltered waters. Wide sand flats alternate with considerable areas of dolerite shingle north of Kelso. *Zostera nana* forms a wide belt on the sand, and is commonly seen at many places in the Estuary towards Launceston. Kelso Bay, south of Kelso, has a wide *Zostera* belt with numerous *Austrocochlea* *obtusa*, etc., and passes into very sheltered mud flats with *Salinator solida* at one point, while at another a fresh water spring ensures the presence of a small population of *Ophicardelus ornatus*. At the southern end an outcrop of Permian till shows the effect of a small degree of exposure with the re-development of the more northern fauna (Tamar) and the presence of a *Melaraphe* belt. South of this point the shore shows a marked estuarine trend.

West Arm is several miles within the estuary near Beauty Point, and is very sheltered, with very small wave action. There are mud and sand flats, with Permian mudstone platforms. The geology has been reviewed by the writer (1955). There is a good deal of resemblance to Pipe Clay Lagoon (Guiler 1951) and a direct comparison is made between these two localities in Table 2. The presence of the mudstone platforms, however, introduces an additional element, for there is little by way of firm substratum in the southern locality. At West Arm *Venerupis crenata* and *Onchidella patelloides* are numerous and assist in adding individuality to this locality. *Velecumantus australis* is very numerous, and is the dominent species on parts of the shore. It is present in Kelso Bay and on parts of the East Coast in shelter. It is more common again at Port Arthur, where there are very sheltered mud flats, and is present in Pipe Clay Lagoon. In West Arm at one point there is an important occurrence of *Galeolaria caespitosa*, the tubes of which provide much shelter and are favoured by *Onchidella*. A curious feature of the West Arm is the tolerance of its fauna to considerable variation in salinity, and sometimes to turbidity. The crab *Mictyris* is also numerous here.

At Bridport several types of shore exist. The Brid and Forester Rivers form a small estuary, which widens near the mouth into a small sandy bay. Above the beach there is some marshy ground, with pools where *Salinator solida* is present. East of the mouth there is unbroken sandy beach, while to the west the beach is littered with granite boulders, some of large size. Further west there is a rocky shore of Silurian metamorphic sediments. A feature of the rocky shores is the development of *Modiolus pulex*. The sandy beach is distinguished by the presence of considerable numbers of *Cardium racketti* and *Glycymeris* (*striatularis*) *suspectus* Iredale, which is in reduced numbers westerly. *Glycymeris flabellatus* Tenison-Woods also appears here. Another important North Coast bivalve which appears here is *Macoma deltoidalis* (Family Tellinidae), which is more common in sheltered areas, such as West Arm, than on the exposed beaches, where it lives lower on the shore.

East Coast.

Ocean beaches bring a considerable increase in the numbers of *Glycymeris suspectus*, so that dead valves are extremely common. The species has its habitat principally below low tide level, and is mentioned only because it is so common. All Tasmanian sandy beaches with any degree of wave action are distinguished by the presence of *Uber conicum, Amphidesma spp., Austromactra rufescens, Tawera gallinula* associated with *Katelysia scalarina, Flavomala biradiata, Anapella pinguis*, etc., the last named species becoming more common with shelter. Species deserving notice in addition to those listed in Table 2 are *Solen vaginoides Callanaitis disjecta* and *Placamen placidum*. The last-named is commonly observed alive on exposed beaches. It is probably a dominent or co-dominant of the lowest Midlittoral of some shores.

George's Bay at St. Helens is a sheltered bay, the flooded south of the river, with wide tidal mudflats. Another such muddy estuary is Little Swan Port. These have typical sheltered faunas which do not here need elaboration. East Coast lagoons are similar on a smaller scale, with the difference that these commonly have a marshy salt flat with volunteer succulents and a population of *Salinator solida* in the Supra-littoral, while the dominant Midlittoral bivalve is *Anapella pinguis*.

A fully exposed quartzite reef was examined on the sandy shore near Scamander. The dominant midlittoral mollusc was *Austromytilus rostratus* forming a dense mat on the side of the rock face, and hence not bearing the full brunt of the wave action. On a flat surface at a lower level the surf barnacle *Catophragmus polymeris* was conspicuous. Patelloids observed included *Cellana solida, C. tramoserica, Siphonaria tasmanica, S. funiculata.* There was no *Melaraphe* belt, but some individuals adhered to the mussels. The highest species was the barnacle, *Chthamalus antennatus*, as the summit of the rock surface in any case probably did not reach the Supralittoral Fringe. In addition, the smooth rock surface made it unsuitable for *Melaraphe*.

At Bicheno the shore is of massive granite, the smooth surface of which is pounded by oceanic wave action. *Melaraphe unifasciata* individuals are very robust, but not plentiful. The upper shore has few individuals, but *Sypharochiton maugeanus* and *Austrocochlea concamerata* were observed near the top of the barnacle belt. *Austromytilus rostratus* follows and subsequently the Patelloids. The shore from the lower parts of the Barnacle Belt rapidly gains in numbers of species and individuals until there are dense populations in which the usual molluscs are ingredients.

In Oyster Bay the rocky shore of dolerite has dense populations of *Austromytilus rostratus*. The most noticeable point with reduction in exposure is the absence of the surf barnacle *Catophragmus*. So far as molluscs are concerned, there are generally more individuals on the higher parts of the shore. However, this generalisation does not apply in some places. On the granite of Cole's Bay, with even less exposure, there are markedly fewer *Austromytilus*, but many more gastropods in the Midlittoral

At Orford, Prosser Bay, the sandy shore yielded a large number of bivalves, and a number of large *Austrocochlea obtusa*. *Katelysia corrugata* and *Eumarcia fumigata* become more noticeable members of the fauna, but there is a more noticeable southern influence in the sub-tidal fauna of bivalves.

At Eagle Hawk Neck there is a sheltered sandy shore fauna on the western side, and an exposed fauna on the East. This, of course, applies also to the rocky shores which are of dolerite and mudstone. At Dunalley the sheltered sandy shore fauna is again present. The sheltered shore species, which may be very common in such places, are rare on the surf beaches.

South Coast.

In the Port Arthur area there is a range of conditions from maximum shelter to maximum exposure at, say, Cape Pillar. At Port Arthur the "sheltered" bivalves *Anapella pinguis* and *Katelysis scalarina* are again part of the fauna. *Velacumantus australis* is present on the mud surface. The area has been dealt with by Cribb (1954) from an algal point of view, and he deals in a general way with the fauna. Despite the apparent shelter, Port Arthur is similar to Cole's Bay in possessing a semi-exposed molluscan fauna. Thus there are found *Cellana solida, Siphonaria tasmanica, S. diemenensis Notohaliotis ruber,* while *Austromytilus rostratus* packs fissures and below these *Mytilus planulatus* is also present. At Point Puer the dolerite rocks are semi-exposed, and support a typical fauna, such as is present on all coasts, showing some degree of exposure and wave action (typified by the presence of a defined *Melaraphe* Belt). Guiler (1952 *b*) has given brief notes on this locality, and the writer has had the opportunity of studying the molluscs collected here by him. The species are those found on the East Coast, but *Fossarina petterdi* and the bivalve *Hiatella australis* may be mentioned.

The sandy shores of Frederich Henry Bay have considerable shelter near Dunalley, but near the entrance to Pipe Clay Lagoon a typical sandy exposed beach fauna was obtained with the addition of *Psammobia livida* and *Electromactra flindersi,* but without *Callanaitis disjecta.* A similar fauna exists at Sandy Bay near Hobart, and here *Katelysia scalarina* and *K. corrugata* are robust shells. *Venerupis diemenensis* is also an addition on these southern shores.

The rock faunas of the Derwent area and D'Entrecastreau Channel bays have been dealt with by Guiler (1950, 1952 *a*) and South Cape Bay (1954 *b*). This latter area has a high degree of exposure, but the usual molluscs are present, although *Melaraphe* is hardly developed as a belt, which is due to the nature of the platform and the absence of a Supralittoral Fringe as such. *Siphonaria diemenensis* is apparently especially plentiful, and is accompanied by *S. tasmanica,* but *Cellana solida* is rare in some places. Guiler (1954 *b*) has reported on a rather different type of shore in the South Cape Bay localities in that algae dominate the intertidal area. It is therefore a pity that no molluscs are available from points further west, because if differences from the typical Tasmanian molluscan fauna exist, they will be found in the south-west corner.

A tabular summary of the species is presented in Table 2, where abbreviations are used as follows:—Supralittoral Fringe (S.L.F.), Midlittoral (ML), Infralittoral Fringe (ILF), Dominant (D), Common (C), Present (P), Victoria (V), New South Wales (N), South Australia (S), and Queensland (Q).

The nature of the substratum is noted briefly after each species name. Occurrences in mainland States are included for comparison.

TABLE 2.

Principal species of Mollusca found on Tasmanian shores.

Gastropoda. Species and substrate.	Place on Shore	West: Exposed	West: Semi-exposed	North: Exposed	North: Semi-exposed	North: Sheltered	East: Exposed	East: Semi-exposed	East: Sheltered	South: Exposed	South: Semi-exposed	South: Sheltered	Max. Shelt.: West Arm	Max. Shelt.: Pipe Clay Lagoon	Max. Shelt.: East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
Haliotidae																			
Notohaliotis ruber	ILF	P	...	C	...	...	P	C	...	P	P	...	...	...	...	V	S	N	...
(Leach) rocks																			
Scissurellidae																			
Scissurella ornata	ILF	...	...	...	...	...	P	...	...	P	...	...	...	...	...	...	...	N	...
May algae																			
Fissurellidae																			
Scutus antipodes	ML	...	...	P	...	...	P	...	...	P	...	...	...	...	...	V	...	N	Q
Montfort rocks																			
Montfortula conoidea	ML	...	...	C	P	...	...	C	...	...	C	...	...	...	...	V	S	...	Q
(Reeve) rocks (*Galeolaria* Belt)																			
Montfortula rugosa	ML	P	...	P	...	...	...	P	...	...	...	...	...	...	...	V	S	...	...
(Quoy and Gaimard) rocks, (*Gal.* Belt)																			
Sophismelepas nigrita	ILF	...	...	P	...	...	...	...	...	...	...	...	...	...	...	V	S	N	...
(Sowerby) rocks																			
Patellidae																			
Patellanax peroni	ILF	C	...	P	...	...	C	...	...	...	...	...	...	...	...	V	S	N	...
(Blainville) rocks																			
P. chapmani	ILF	P	P	P	...	...	...	...	...	...	...	...	...	...	...	V	S	...	...
(T. Woods) rocks																			
P. victoriana	ILF	P	...	...	...	...	...	...	...	P	...	...	...	...	...	V	S	...	...
Singleton rocks																			
Cellana solida	ML	C	...	D	...	...	C	P	P	C	P	P	...	...	...	V	S	...	...
(Blainville) rocks (Patelloid Belt)																			
C. tramoserica	ML	...	...	P	...	...	P	...	...	...	...	...	...	...	...	V	S	N	Q
(Sowerby) rocks																			

	Place on Shore	West: Exposed	West: Semi-exposed	North: Exposed	North: Semi-exposed	North: Sheltered	East: Exposed	East: Semi-exposed	East: Sheltered	South: Exposed	South: Semi-exposed	South: Sheltered	Max. Shelt.: West Arm	Max. Shelt.: Pipe Clay Lagoon	Max. Shelt.: East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
Acmeidae																			
Patelloida alticostata (Angas) rocks	ML	...	P	C	P	...	P	C	...	P	P	P	...	...	...	V	S	N	...
P. latistrigata (Angas) rocks (Patelloid Belt)	ML	P	...	P	...	...	P	...	...	P	...	...	...	...	...	V	S	...	...
Chiazacmea flammea (Quoy and Gaimard) rocks	ML	...	...	...	P	...	...	P	...	...	...	P	...	...	...	V	...	N	...
Notoacmea mayi (May) rocks	ML	...	P	...	...	...	P	P	...	...	P	...	...	...	...	V	...	...	...
Notoacmea petterdi (T. Woods) rocks	ML	P	...	P	...	...	C	...	...	...	P	...	...	...	...	V	...	N	Q
Notoacmea scabrilirata (Angas) rocks	ML	...	P	...	...	...	...	...	P	...	...	P	C	...	...	V	S	N	...
Conacmaea corrosa Oliver rocks	ML	...	...	...	...	...	...	...	...	P	P	...	...	...	...	...	...	...	...
C. subundulata (Angas) rocks	ML	P	...	C	P	...	...	...	...	...	...	P	...	C	...	...	S	N	...
Actinoleuca calamus (Crosse and Fischer) rocks	ILF	P	...	P	P	...	P	...	...	P	...	...	...	...	...	V	S	...	...
Trochidae																			
Macroclanculus undatus (Lamarck) rocks	ILF	...	...	P	...	...	...	C	...	...	P	...	...	...	...	V	S	N	...
Mesoclanculus plebejus (Philippi) rocks	ILF	...	...	C	...	...	...	C	...	...	C	...	...	...	...	V	S	N	...
Phasianotrochus eximius (Perry) algae	ILF	...	...	C	...	...	...	C	...	...	C	...	...	...	...	V	S	N	...

Phasianotrochus bellulus	ILF	...	...	C	...	...	...	C	...	...	...	...	...	...	...	V	S	...	...
(Dunker) algae																			
Thalotia conica	ILF	...	...	P	C	...	...	...	...	...	...	...	...	...	...	V	S	...	...
(Gray) algae																			
Bankivia fasciata	ILF	...	...	C	...	...	C	...	...	C	...	...	...	...	...	V	S	N	...
(Menke) algae																			
Austrocochlea obtusa	ML	...	P	...	P	D	...	...	C	...	...	C	C	D	C	V	...	N	Q
(Dillwyn) sand, mud																			
A. constricta	ML	...	...	C	P	...	C	...	...	C	C	...	...	...	...	V	...	...	...
(Lamarck) rocks																			
Fractamilla concamerata	ML	...	P	C	C	...	C	C	C	C	...	...	...	...	...	V	S	N	...
(Wood) rocks																			
Chlorodiloma odontis	ML	P	...	C	P	...	C	C	...	...	P	P	...	...	...	V	S	...	...
(Wood) rocks																			
C. adelaidae	ILF	...	...	P	P	...	P	...	...	...	...	...	...	...	...	V	S	...	...
(Philippi) rocks																			
Fossarina legrandi	ILF	P	...	...	...	...	P	...	...	P	...	...	...	...	...	V	S	N	...
(Petterd) rocks																			
F. petterdi	ILF	P	...	...	...	...	...	...	...	C	C	...	...	...	...	V	S	...	...
(Crosse) rocks																			
Stomatellidae																			
Herpetopoma baccata	ILF	...	...	P	...	...	...	P	...	...	...	...	...	...	...	V	...	N	...
(Menke) rocks																			
Turbinidae																			
Subninella undulata	ML	P	...	C	C	...	P	C	...	P	C	...	...	...	...	V	S	N	Q
(Solander) rocks, sand																			
Micrastraea aurea	ML	...	P	C	...	...	...	P	...	...	P	...	...	...	...	V	S	...	...
(Jonas) rocks																			
Eutropidae																			
Phasianella australis	ILF	...	...	C	C	...	...	C	...	...	C	C	...	...	...	V	S	...	...
(Gmelin) algae																			
Mimelenchus ventricosa	ILF	...	...	C	...	...	...	...	...	...	...	...	...	...	...	V	S	N	...
(Swainson) algae																			
Neritidae																			
Melanerita melanotragus	ML	P	...	D	P	...	...	P	...	...	...	...	...	...	...	V	S	N	Q
(Smith) rocks																			

	Place on Shore	West Exposed	West Semi-exposed	North Exposed	North Semi-exposed	North Sheltered	East Exposed	East Semi-exposed	East Sheltered	South Exposed	South Semi-exposed	South Sheltered	Max. Shelt. West Arm	Max. Shelt. Pipe Clay Lagoon	Max. Shelt. East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
Littorinidae																			
Melaraphe unifasciata (Gray) rocks	SLF	D	...	D	P	P	D	P	...	D	P	...	P	...	...	V	S	N	Q
M. praetermissa (May) rocks	SLF	...	...	P	...	...	P	...	...	P	...	...	—	...	...	V	S	...	...
Bembiciidae																			
Bembicium melanostomam (Gmelin) rocks	ML		...	...	P	...	...	P	...	...	...	C	...	...	...	V	S	N	Q
B. auratum (Quoy and Gaimard) rocks	ML	...	...	...	...	P	...	...	P	...	...	P	D	P	...	V	...	N	...
B. nanum (Lamarck) rocks	ML	P	...	C	P	...	C	P	...	P	P	...	...	...	...	V	S	...	...
Assiminidae																			
Assiminia brazieri (T. Woods) mud, rocks	ML	...	...	...	C	C	...	...	P	...	...	...	C	D	P	V	S	...	...
Vermetidae																			
Serpulorbis sipho (Lamarck) rocks, stones	ILF	...	P	...	P	...	...	P	...	...	...	...	...	...	...	V	S	N	...
Cerithidae																			
Zeacumantus diemenensis (Quoy and Gaimard) sandy mud	ML	...	P	...	C	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Eubittium lawleyanum (Crosse) sandy mud	ML	...	...	...	C	D	...	...	...	...	...	...	D	D	P	V	S	...	...
Cacozeliana granarium (Kiener) sand	ML	...	...	...	D	...	...	...	...	...	...	...	...	...	...	V	S	...	...
Velacumantus australis (Quoy and Gaimard) mud	ML	...	...	...	P	P	...	...	P	...	...	P	D	P	...	V	...	...	...

Hipponicidae																			
Sabia conica (Schumacher) shells, etc.	ILF	...	P	P	P	...	P	P	...	...	...	...	...	...	...	...	S	...	...
Naticidae																			
Uber aulacoglossa (Pilsbry and Vanatta) sand	ML	...	...	P	P	..	...	...	...	...	.	..	P	...	...	V	S	N	..
Uber conicum (Lamarck) sand	ML	P	...	C	C	.	P	C	...	...	C	...	...	P	...	V	S	N	Q
Ectosinum zonale (Quoy and Gaimard) sand	ILF	...	...	P	...	.	...	P	...	...	...	...	...	...	...	V	S	N	...
Cymatiidae																			
Cymatilesta barthelemyi (Bernardi) rocks	ILF	...	...	P	..	...	P	P	...	...	...	...	...	...	..	..	...	...	...
Charonia rubicunda (Perry) rocks	ILF	...	..	...	...	...	..	P	...	...	...	...	...	...	...	...	...	N	...
Negyrina subdistorta (Lamarck) rocks	ML	..	...	P	...	...	...	...	...	...	...	..	.	...	...	V	S	...	..
Cymatiella verrucosa (Reeve) rocks	ILF	...	P	P	...	...	...	...	...	...	..	...	...	...	...	V	S	...	...
Muricidae																			
Pterynotus triformis (Reeve) rocks	ILF	..	...	C	P	...	...	P	...	...	...	..	...	...	...	V	S	...	...
Galfridus eburneus (Petterd) rocks	ILF	...	...	P	...	...	...	P	...	...	.	...	...	...	...	V	S	...	...
Thaididae																			
Dicathais orbita (Gmelin) rocks	ILF	...	...	P	...	...	C	C	...	...	...	...	...	...	...	V	...	N	Q
D. textiliosa (Lamarck) rocks	ILF	P	...	C	...	...	...	...	...	...	...	...	...	...	...	V	S	...	..
Neothais baileyana (T. Woods) rocks	ML	...	...	P	..	...	...	...	...	P	...	..	...	...	...	V	S	...	...
Lepsithais vinosa (Blainville) rocks	ML	P	P	C	C	C	C	P	P	...	P	...	C	...	...	V	S	N	...
Lepsiella reticulata (Lamarck) rocks	ML	...	...	...	...	...	C	...	...	...	P	..	...	...	...	V	S	..	..

	Place on Shore	West Exposed	West Semi-exposed	North Exposed	North Semi-exposed	North Sheltered	East Exposed	East Semi-exposed	East Sheltered	South Exposed	South Semi-exposed	South Sheltered	Max. Shelt. West Arm	Max. Shelt. Pipe Clay Lagoon	Max. Shelt. East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
Agnewia tritoniformis (Blainville) rocks	ML			P				P			P					V		N	
Pyrenidae																			
Zemitrella semiconvexa (Lamarck) rocks	ILF			C	P			P								V		N	
Zemitrella lincolnensis (Reeve) rocks	ILF			P				P			P					V	S	N	
Z. tayloriana (Reeve) rocks	ILF							P	P		P							N	
Z. vincta (Tate) rocks	ILF			P				P			P					V	S		
Z. acuminata (Menke) rocks	ILF		P																
Zella beddomei (Petterd) rocks	ILF								P							V			
Buccinidae																			
Cominella eburnea (Reeve) rock, sand	ML				C			C								V	S		
C. lineolata (Lamarck) rock, sand, *Zostera*	ML	P	P	C	C	C	C	C	C	C	C	C	P	P		V	S		
C. acutinodosa (Reeve) sand, mud	ML				C	P							P			V	S		
Tasmeuthria clarkei (T. Wood) rocks	ILF										P					V	S		
Fax tenuicostata (T. Woods) rocks	ML	P					P			P									

Berylsma grandis	ILF	...	...	P	P	...	...	P	...	...	...	...	...	...	...	V	S	...	...
(Gray) rocks																			
Nassariidae																			
Parcanassa burchardi	ML	...	...	...	C	C	...	...	...	...	...	...	C	...	...	V	S	N	...
(Philippi) sandy mud																			
P. pauperata	ML	...	...	...	C	C	...	...	C	...	...	P	P	C	...	V	S	N	...
(Lamarck) sand, muddy sand																			
Fasciolariidae																			
Pleuroploca australasiae	ML	...	...	P	P	...	...	C	..	...	C	...	P	C	...	V	...	N	...
(Perry) rock, sand																			
P. coronata	ML	...	...	C	C	P	...	...	...	...	...	...	...	...	...	V	S	N	...
(Lamarck)																			
Propefusus pyrulatus	ML	...	...	P	...	...	...	...	...	...	...	...	...	...	...	V	...	N	...
(Reeve) rocks																			
P. undulatus	ML	...	...	P	...	...	...	...	...	...	P	P	...	...	...	V	...	...	...
(Perry) rocks																			
Olividae																			
Alocospira marginata	ILF	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	S	...	...
(Lamarck) sand																			
Alocospira oblonga	ILF	...	...	P	...	...	...	...	...	...	...	...	...	...	...	V	...	...	...
(Sowerby) sand																			
Baryspira petterdi	ILF	...	...	P	...	...	...	...	...	...	...	...	...	...	...	V	S	...	...
(Tate) sand																			
Mitridae																			
Mitra glabra	ILF	...	...	P	...	...	...	P	...	.	...	...	...	...	...	V	S	N	...
Swainson rocks																			
Mitra rhodia	ILF	...	P	P	...	...	...	...	...	...	..	...	...	...	...	V	S	N	...
Reeve rocks																			
Volutidae																			
Amorena undulata	ILF	...	...	P	...	...	...	P	...	...	P	...	...	...	...	V	S	...	...
(Lamarck) sand																			
Lyria mitraeformis	ILF	...	...	P	...	...	...	...	...	...	...	...	...	...	...	V	S	...	...
(Lamarck) sand																			
Marginellidae																			
Marginella formicula	ILF	..	...	...	...	...	...	C	P	...	C	...	...	...	...	...	S	...	...
Lamarck sand																			

		West		North			East			South			Max. Shelt.						
	Place on Shore	Exposed	Semi-exposed	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	West Arm	Pipe Clay Lagoon	East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
M. muscaria	ILF	...	...	...	...	...	...	C	C	...	...	...	...	...	...	V	S	N	...
Lamarck sand																			
M. pygmaeoides	ILF	...	...	P	...	...	P	P	...	P	...	...	...	...	...	V	S	...	...
Singleton rocks																			
M. tasmanica	ILF	...	...	...	...	...	P	...	...	...	...	...	...	...	...	V	S	N	...
T. Woods sand																			
Turridae																			
Austrodrillia beraudiana	ILF	...	P	P	P	...	...	...	...	...	...	...	...	...	...	V	...	N	...
(Crosse) rocks																			
Conidae																			
Floraconus anemone	ILF	...	P	C	P	...	...	C	...	...	...	...	...	...	...	V	S	...	...
(Lamarck) rocks																			
Bullariidae																			
Quibulla tenuissima	ILF	...	...	P	P	...	...	P	...	...	...	...	...	...	...	V	S	N	...
(Sowerby) sand																			
Philinidae																			
Philine angasi	ILF	...	...	C	...	...	P	C	...	...	C	...	...	...	...	V	S	...	...
(Crosse and Fischer) sand																			
Elobiidae																			
Ophicardelus ornatus	SLF	...	...	...	...	P	...	...	P	...	...	...	C	...	...	V	S	N	...
(Ferussac) rock, muddy sand																			
Onchidiidae																			
Onchidella patelloides	ML	P	...	...	P	...	P	...	...	...	...	...	C	...	...	V	...	N	...
Quoy and Gaimard rocks																			

Amphibolidae																			
Salinator fragilis	ML	...	...	...	C	C	...	...	C	...	...	..	D	C	...	V	S	...	...
(Lamarck) muddy sand, *Zostera* Belt																			
S. solida	ILF	...	...	...	..	D	...	...	C	..	..		D	D	D	V	S	...	...
(Martens) mud, sand																			
Siphonariidae																			
Siphonaria diemenensis	ML	C	...	D	C	C	C	C	C	C	C	C	C	...	...	V	S	N	
Quoy and Gaimard rocks																			
Patelloid Belt																			
S. tasmanicus	ML	P	..	P	...	...	C	...	...	...	P	P	...	...	...	V	S	..	.
T. Woods rocks																			
S. funiculata	ML	...	...	P	...	..	P	P	P	...	..	P	.	...	...	...	S	...	..
Reeve rock																			
Pelecypoda																			
Arcidae																			
Arca pistachia	ILF	...	P	C	P	...	...	P	...	...	..	..	...	..	...	V	S	N	..
Lamarck rocks																			
Glycymeridae																			
Glycymeris (*striatularis*) *suspectus*	ILF	...	..	C	...	..	C	...	...	...	...	P	...	...	...	...	...	...	.
Iredale sand																			
Vulsellidae																			
Vulsella vulsella	ILF	...	...	P	...	...	...	P	...	...	...	...	..	...	...	...	...	N	..
(Linne) rocks (sponges)																			
Vulsella spongiarum	ILF	...	..	P	...	...	...	...	...	...	...	.	...	...	...	V	S	...	..
Lamarck rocks																			
Pinnidae																			
Atrina tasmanica	ILF	...	...	P	...	...	...	...	...	...	..	...	...	..	...	V	...	...	...
(T. Woods) sand																			
Pteriidae																			
Electroma georgiana	ILF	...	...	C	...	...	...	...	C	P	...	P	P	..	...	V	S	...	...
(Quoy and Gaimard) algae																			
Ostreidae																			
Ostrea angasi	ILF	...	...	...	...	P	...	...	...	P	..	..	P	P	...	...	...	N	...
Sowerby rock, mud																			

	Place on Shore	West Exposed	West Semi-exposed	North Exposed	North Semi-exposed	North Sheltered	East Exposed	East Semi-exposed	East Sheltered	South Exposed	South Semi-exposed	South Sheltered	Max. Shelt. West Arm	Max. Shelt. Pipe Clay Lagoon	Max. Shelt. East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
Trigonidae																			
Neotrigonia margaritacea (Lamarck) mud, sand	ILF	...	...	...	P	P	...	...	P	P	...	...	...	...	...	V	...	N	...
Pectinidae																			
Mimachlamys asperrima (Lamarck) sand, sponges	ILF	...	...	...	P	P	...	...	P	...	...	...	P	...	...	V	S	N	...
Limidae																			
Pelecypoda																			
Species																			
Austrolima gemina Iredale rocks	ILF	...	...	P	...	...	...	...	...	...	...	...	...	...	...	...	S	...	...
Anomiidae																			
Monia ione Gray rocks	ILF	...	...	P	...	...	...	P	...	...	P	...	...	...	...	V	S	N	...
Mytillidae																			
Mytilus planulatus Lamarck rocks	ML	...	...	...	...	...	...	C	C	...	C	C	...	P	...	V	S	N	...
Austromytilus rostratus (Dunker) rocks	ML	C	...	...	...	...	D	D	...	D	D	...	...	P	...	V	S	N	...
A. erosus (Lamarck) rocks, sand	ML	...	P	...	C	P	...	...	...	...	...	...	...	...	...	V	S	...	...
Modiolus delinificus Iredale rocks? not taken alive		...	...	P	P	...	P	...	...	...	...	..	...	...	...	V	S	N	..
M. cottoni Laseron rocks, 1 sp. Bridport alive	ILF	...	P	P	...	...	...	...	...	...	...	...	...	...	...	V	S	N	...

M. pulex	ML	P	P	D	P	C	P	...	...	...	...	...	D	...	...	V	S	N	...
(Lamarck) rocks																			
Laternulidae																			
Laternula creccina	ILF	...	...	P	C	...	...	...	...	...	...	...	...	...	...	V	S	N	...
(Reeve) mud, sand																			
L. tasmanica	ILF	...	...	...	...	...	...	...	...	...	...	P	C	...	...	...	...	...	...
(Reeve) mud																			
Crassetellidae																			
Eucrassatella kingicola	ILF	..	...	P	...	...	...	...	...	...	...	...	...	...	...	V	...	N	..
(Lamarck) sand																			
Leptonidae																			
Kellia australis	ML	P	...	C	P	P	P	...	...	C	P	P	...	...	...	V	S	N	..
(Lamarck) rocks																			
Luciniae																			
Wallucina assimilis	ML	...	...	...	...	...	...	...	...	...	...	...	...	P	...	V	...	N	..
(Angas) sand																			
Cardiidae																			
Cardium racketti	ILF	...	...	C	P	...	...	P	...	...	P	..	...	...	...	V	S	N	..
Donovan sand																			
C. cygnorum	ILF	...	...	P	...	...	...	...	...	...	P	...	...	...	...	V	S	N	..
Deshayes sand																			
Veneridae																			
Dosinia coerulaea	ILF	...	...	C	...	...	P	P	...	...	P	...	...	...	...	V	...	N	...
(Reeve) sand																			
Paradione kingii	ILF	..	...	P	...	...	P	P	...	...	P	...	...	...	...	V	S	N	..
(Gray) sand, rare alive																			
Pelecypoda																			
Species																			
Paradione diemenensis	ILF	...	...	P	..	...	...	C	...	..	...	...	...	...	...	V	...	...	..
(Hanley) sand																			
Callanaitis disjecta	ILF	..	.	C	...	...	...	P	...	...	...	...	...	...	...	V	S	N	..
(Perry) sand																			
Placamen placidum	ML	...	...	C	...	...	C	C	...	...	P	..	...	...	...	V	S	...	...
(Philippi) sand																			
Tawera gallinula	ILF	...	...	C	P	..	C	C	...	...	...	...	...	...	...	V	S	N	..
(Lamarck) sand																			

	Place on Shore	West		North			East			South			Max. Shelt.						
		Exposed	Semi-exposed	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	West Arm	Pipe Clay Lagoon	East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
T. lagopus (Lamarck) sand	ILF	..	..	P	...	...	P	P	...	...	...	...	...	...	...	V	S	N	...
Venerupis exotica Lamarck sand	ILF	...	..	P	...	...	P	...	...	...	P	...	...	...	...	V	...	...	...
V. diemenensis Quoy and Gaimard sand	ILF	...	...	...	...	...	...	...	...	...	P	...	...	P	...	...	...	...	...
V. crenata Lamarck rock	ML	...	...	...	...	C	...	...	...	...	...	...	C	...	...	V	S	N	...
V. fabagella (Deshayes) sand	ILF	..	..	P	...	...	...	P	...	...	...	...	...	...	...	V	...	N	...
V. galactites (Lamarck) sand	ILF	..	..	P	P	..	...	...	...	...	..	...	...	...	...	V	S	N	...
Katelysia scalarina (Lamarck) sand, muddy sand	ML	...	..	P	P	C	P	P	P	...	..	C	D	D	P	V	S	N	...
K. peroni (Lamarck) sandy mud	ML	.	...	...	P	[illegible]	...	...	...	...	...	...	D	...	...	V	S	...	...
K. corrugata (Lamarck) sand	ML	..	..	...	...	..	P	...	..	...	...	C	...	D	...	...	S	...	...
Eumarcia fumigata (Sowerby) sand	ILF	...	..	P	...	...	..	P	...	...	P	...	...	...	...	V	S	N	...
Tellinidae																			
Tellina albinella (Lamarck) sand	ILF	...	..	P	...	..	..	P	...	...	P	..	...	..	...	V	S	N	..
Macoma deltoidalis (Lamarck) sand, sandy mud	ML	...	..	P	P	P	..	...	...	..	...	..	C	..	...	V	S	...	...

Psammobiidae																			
Flavomala biradiata	ML	...	...	P	C	...	...	P	...	...	...	...	...	...	...	V	S	N	...
(Wood) sand, sandy mud																			
Psammobia livida	ML	...	...	...	...	...	...	...	...	...	C	...	...	...	...	V	S	N	...
Lamarck sand																			
Solenidae																			
Solen vaginoides	ILF	...	...	P	...	...	C	...	...	...	P	...	...	...	...	V	S	N	...
Lamarck sand																			
Mactridae																			
Mactra pura	ILF	...	...	P	P	...	...	...	...	...	...	...	...	...	...	V	S	...	...
Deshayes sand																			
Austromactra rufescens	ILF	...	...	P	...	...	...	C	...	...	P	...	...	P	...	V	S	...	..
(Lamarck) sand																			
Electromactra flindersi	ILF	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	S	...	..
Cotton and Godfrey sand																			
Notospisula trigonella	ML	...	...	...	...	...	...	...	P	...	...	...	...	P	...	...	S	...	..
(Lamarck) sandy mud																			
Anapella pinguis	ML	...	...	P	C	...	...	P	D	...	...	P	...	D	D	V	S	...	..
(Crosse and Fischer) sand, sandy mud																			
Amphidesmatidae																			
Amphidesma angusta	ML	...	...	D	...	...	C	C	...	...	...	...	...	...	...	V	S	N	..
(Reeve) sand																			
A. cuneata	ML	...	...	...	...	...	...	P	...	...	...	...	...	...	..	V	S	N	...
(Lamarck) sand																			
A. erycinaea	ML	...	...	...	...	...	...	P	...	...	P	...	...	...	...	V	...	...	...
(Lamarck) sand																			
A. nitida	ML	...	...	...	...	P	...	...	...	...	...	...	...	P	...	V	...	...	...
(Deshayes) mud																			
Hiatellidae																			
Hiatella australis	ILF	...	...	...	...	...	...	...	...	P	...	...	...	...	...	V	S	N	...
(Lamarck) rock																			
Crepipoda																			
Ischnochitonidae																			
Ischnochiton lineolatus	ILF	...	...	P	...	...	P	...	...	...	P	...	...	...	...	V	S	...	...
(Blainville) rocks																			
I. elongatus	ILF	...	P	C	...	...	C	...	...	C	...	...	...	...	...	V	S	...	...
(Blainville) rocks																			

		West		North			East			South			Max. Shelt.						
	Place on Shore	Exposed	Semi-exposed	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	Exposed	Semi-exposed	Sheltered	West Arm	Pipe Clay Lagoon	East Coast Lagn.	Victoria	South Australia	New South Wales	South Queensland
Heterozona subviridis Iredale and May rocks	ILF	P	...	...	...	...	P	...	...	...	...	P	...	...	...	V	S	...	...
Ovatoplax mayi (Pilsbry) rocks	ILF	...	...	...	...	...	P	...	...	...	...	...	...	...	...	V	S	...	...
Ischnoradsia eyanida (Sowerby) rocks	ML	...	...	...	...	...	P	...	...	P	...	...	...	...	...	...	...	...	...
I. novaehollandiae (Reeve)	ML	...	...	C	...	...	...	...	...	...	...	...	...	...	...	V	S	...	...
Cryptoconchidae																			
Acanthochiton sueurii (Blainville) rocks	ML	...	P	...	...	P	...	...	...	...	...	...	...	P	...	V	S	...	...
Plaxiphoridae																			
Poneroplax albida (Blainville) rocks	ML	...	...	P	...	...		P	...	.	...	...	...	...	...	V	S	...	...
P. costata (Blainville) rocks	ML	P	...	...	...	...	...	...	...	P	P	..	...	...	...	V	S	...	...
Chitonidae																			
Amaurochiton glaucus (Gray)	ML	...	...	...	...	...	...	...	...	...	C	C	...	...	...	...	...	...	...
Sypharochiton maugeanus Iredale and May rocks	ML	P	...	C	C	C	C	C	...	C	C	C	...	C	.	...	S	...	...

In Table 2 the distribution of species is according to the writer's knowledge, and is not necessarily complete. In indicating the place on the shore occupied by the various species, the writer has been guided by the presence of the particular species in a living condition in most cases. In a few instances a mollusc may be very rare alive in the tidal area and its true habitat may be only below tide marks. This applies in the case of certain bivalves.

Zoogeography.

A map showing the extent of the zoogeographical regions in Australia has been provided by Iredale (1937). In Table 2 the regional names have not been used, but State names inserted for convenience. According to Iredale, the Peronian Region extends from Southern Queensland to the East Coast of Tasmania. The Flindersian Region extends from Western Australia to the West Coast of Tasmania and includes the North Coast. A Maugean Sub-region includes the East Coast of Tasmania.

The writer holds that the Peronian Region has its affinities with the deep water mollusca of the East Coast, and this seems in accord with Iredale's opinion. The North Coast shows affinities with the Flindersian region, in some places strongly, but in general the reason for this is as much ecological as geographical. The Tasmanian aspect is too strong to be submerged by inclusion of this area in the Flindersian region without considerable qualification. Bennett and Pope (1953) suggested that the Maugean Province should be extended to include all Tasmania and the Victorian exposed coast. The writer is in accord with this opinion. Hence Tasmania is here suggested as representative of the Maugean Region with direct affinities with Victoria, particularly the exposed Victorian coast. Affinities with the Peronian Region exist in the East Coast fauna, especially in forms living below low tide. Affinities with the Flindersian Region exist on the West Coast and North Coast, being most noticeable in the forms between tides on the North Coast.

The Bass Strait area has not been discussed to any extent in this paper, but it seems that the Maugean Region should include the Bass Strait Islands. There are very noticeable Peronian influences on Flinders Island, and Flindersian on King Island.

Dr. Guiler has several times made observations concerning the relationships of the Tasmanian rocky shores to those of the Mainland (1951 *b*, 1952 *c*, 1954, 1955), and to those of New Zealand and South Africa (1952 *c*).

With few exceptions, the sandy shore molluscs living in Tasmania which are not found also in Victoria are peculiarly Tasmanian species. The writer has used the South Australian name for a south Tasmanian shell, *i.e.*, *Electromactra flindersi* Cotton and Godfrey. The Victorian shell is the Peronian *E. antecedens* Iredale, which is very closely related. Our shell may actually be this species, but without comparative material the matter is uncertain. *Laternula tasmanica* (Reeve) is the Tasmanian representative of the mainland *Laternula recta* (Reeve). There is not a great deal of difference between this species and the north Tasmanian form.

Cotton (in Crocker and Cotton 1946) summarised the main sand beach and estaurine beach shells of South Australia, and these compare closely with those of Tasmanian beaches. *Glycymeris radians* listed by

Cotton is, however, rare in the Tasmanian or Maugean Region. Of the estaurine shells, *Anapella adelaidae* and *Laternula recta* are not present here, This applies equally to *Assiminea granum* Menke. South Australian beaches have been treated generally by Johnston and Mawson (1946) and by Cotton and Godfrey (1938) and Cotton (1954 *b*). The most important difference which emerges is the presence of the "Pipi" *Plebidonax deltoides* (Lamarck) on the exposed beaches. This mollusc is present in similar situations in the Peronian Region. In New Zealand the "Toheroa," *Amphidesma ventricosum* Gray, is equivalent in occurrence and habitat to the "Pipi." In Tasmania, however, there appears to be no similar occurrence, and certainly nothing of economic value as are the above species. It is easy to show that Tasmanian species are related to or identical with Mainland species. It is on the Mainland rather than in Tasmania that different species appear in number, and different ecological features are indicated. This has been shown amply in the rocky shore faunal studies, and it should be expected on the sandy beach. It is less easy to show from sandy beach molluscs alone that Tasmania should be regarded as a distinct Region. In checking against New South Wales beach shells as detailed by Allan (1946), greater differences are observable. Several Tasmanian species are present, but in other cases the Tasmanian species are replaced by other species, *e.g.*, *Placamen molimen*, *Notospisula producta*.

On the New South Wales tidal flat (Allan 1947 *a*) *Pyrazus ebininus* and *Anadara trapezia* are significant. The first species lived here in Tasmania, and sub-fossil specimens are found, but its place is now taken by *Velacumantus australis*, which lies about on the tidal flat in a similar manner. *Anadara trapezia* probably did not extend south of the Bass Strait Islands in the past, but it still exists in Victoria. There seems to be no equivalent species in Tasmania. The southern *Katelysia spp.*, *Macoma deltoidalis*, and *Anapella pinguis*, are replaced in New South Wales by *Paphia turgida*, *Proxichione matona*, *Circe sugillata*, etc., but it is of interest that *Flavomala biradiata*, *Laternula creccina* and *Ostrea angasi* are common to the two Regions.

Summary.

The more detailed information now available on the Tasmanian intertidal molluscan fauna has made possible a new appraisal of its relationships. It is closely comparable with the faunas of the nearby mainland coasts, and less so with the faunas of Western Australia, New South Wales and southern Queensland. There is little resemblance to the tropical Australian fauna, but some affinity with New Zealand is recognised. Contrasts on the Australian coast may well be as much due to facies as to any other factor.

The mollusca of the east and south-east coasts of Tasmania show Peronian affinities, while those of the north and west show Flindersian affinities. Moreover, Bass Strait is a faunal "cross roads," so sharp boundaries for the zoogeographic regions are not desirable there. Nevertheless, the Tasmanian fauna has an individuality of its own, which tends to indicate that a separate region should be recognised here. Hence the writer agrees with Bennett and Pope (1953) that a Maugan Biogeographical Province may suitably include all Tasmania, and, in addition, the exposed coast of Victoria.

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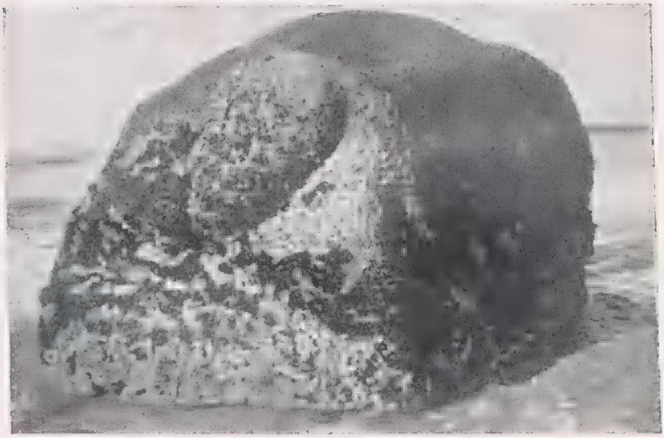

Text figure 2:
Granite boulders at Bridport, north-east Tasmania, showing belt of *Modiolus pulex* Lamarck (Black).

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LIST OF MEMBERS

(Members are requested to send immediate notice of any change of address to the Honorary Secretary.)

PROF. R. TUCKER ABBOTT, Ph.D., Academy of Natural Sciences, 19th and Parkway, Phil., Pa., U.S.A.
MISS JOYCE ALLAN, F.R.Z.S., 72 Cremorne Road, Cremorne, N.S.W.
MR. A. E. AXON, 127 Eagle Street, Brisbane, Queensland.
MRS. E. F. AYERS, P.O. Box 282, Mackay, Queensland.
MR. R. ALLINGHAM, 97 William Street, Perth, W.A.
MR. and MRS. G. F. ALKE, 182 Perth Street, Toowoomba, Queensland.
MISS ANDREWS, 2 Gordon Street, Footscray.
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MR. JOHN BATES, C.E. Line, Miriam Vale, Queensland.
MR. L. BLACK, P.O. 10, Leaton, N.S.W.
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MR. and MRS. W. BODE, 26 Robert Street, N. Balwyn.
MISS NANCY BLOCK, 3 Clapham Road, N. Balwyn.
MR. ROBERT BURN, 34 Autumn Street, W. Geelong, Victoria.
MR. and MRS. D. BELL, Emerald Road, Beaconsfield, Victoria.
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MR. RICHARD BRIELL, R. R.1, Box 141, Lexington Pk., Maryland, U.S.A.
MRS. H. M. BIXBY, "Top Side," Bolton Landing, New York, U.S.A.
MR. C. E. BARKER, 27 Wilcott St., Mt. Albert, Auckland, New Zealand.
MR. C. A. CUDDAY, Hyde Park, Park Lane, Townsville, Queensland.
MR. F. S. COLLIVER, University of Brisbane, Queensland.
MRS. CONROY, P.O. Box 829, Cairns, Queensland.
MRS. C. D. CROFTON, P.O. Box 214, Bowen, Queensland.
MRS. L. M. CURRY, "Linga-On," Gay Terrace, Caloundra, Queensland.
MR. R. COBB, 117 Down Street, Ipswich, Queensland.
MR. C. E. COLLINSON, 5 Villa Street, Heidelberg.
MRS. L. CATO, Nepean Highway, Rosebud.
MR. BERNARD C. COTTON, Adelaide Museum, Adelaide, Sth. Australia.
MRS. H. L. CURNOW, 50 Weeroona Avenue, Parkholme, Sth. Australia.
MRS. Z. W. CRAINE, 155 North Broad Street, Norwich, New York, U.S.A.